



Frontiers

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Igniting the imagination

With innovation and new technology,
a "One Boeing" team helps build
SLS—the next space super rocket

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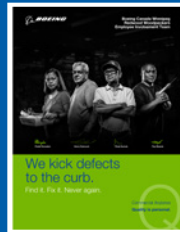
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ADVERTISEMENTS

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

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

14-15



"Enduring Support," which focuses on Boeing's training expertise, is one of several ads in a Boeing Defense, Space & Security campaign highlighting the capabilities Boeing brings to its customers. The ads appear in business, political and trade publications.

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Part of an advertising campaign focused on the Middle East, this ad supports Boeing's partnership with Mubadala and will run in major print publications in the United Arab Emirates. Translated text reads: "Together we grow. Boeing partners with Mubadala to advance the UAE's goal to be a global aerospace manufacturer and supplier. Leading through partnership."

ETHICS QUESTIONS

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

IAM PROMOTIONS

No promotions listed for periods ending Dec. 6, 13, 20 and 27 and Jan. 3, 10, 17 and 24.

FSC LOGO



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Redwood Woodpeckers
Employee Involvement Team



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Rosita Gonzales

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We kick defects to the curb.

Find it. Fix it. Never again.

Commercial Airplanes
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Quality is personal.

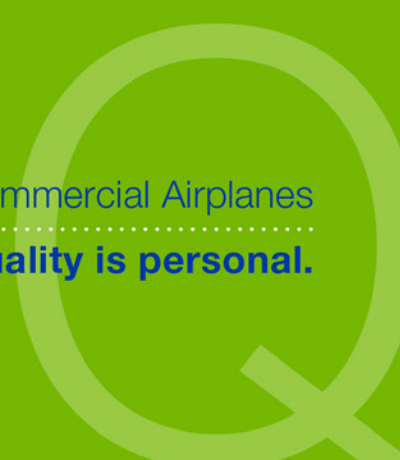


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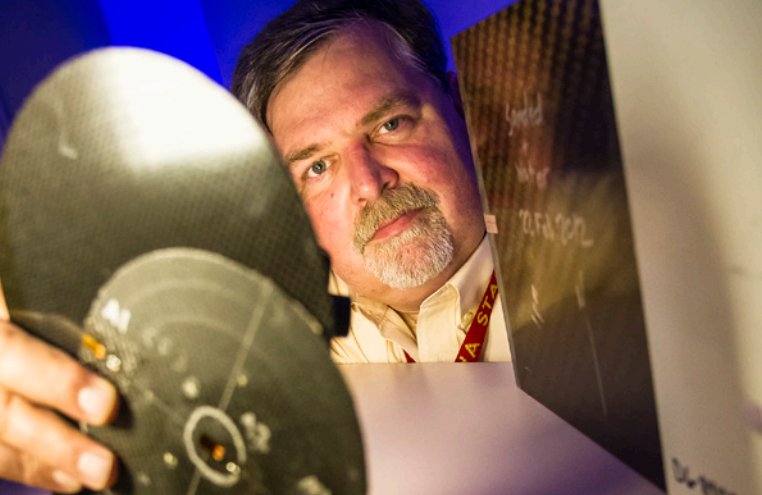
22 THE ROCKET MAKERS

It's the kind of engineering challenge and journey of exploration that fires the imagination, just as the Apollo moon landing program did in the 1960s. Today, across the enterprise, a diverse "One Boeing" team of employees is helping build a powerful new rocket that will make possible missions into deep space, perhaps even one day to Mars. The Space Launch System rocket is far more powerful and advanced than the Saturn V that hurled the Apollo spacecraft toward the moon. At NASA's vast Michoud Assembly Facility near New Orleans, Boeing employees are using the latest technology and innovation to construct the rocket's massive first stage, which is more than 200 feet (60 meters) tall and 27 feet (8 meters) wide.

COVER: JAY SCHMITT, A QUALITY SPECIALIST FOR THE SPACE LAUNCH SYSTEM, INSPECTS A NEWLY WELDED BARREL FOR THE ROCKET'S CORE STAGE AT NASA'S MICHLOUD ASSEMBLY FACILITY. BOB FERGUSON/BOEING

PHOTO ILLUSTRATION: ARTIST'S CONCEPT OF THE SPACE LAUNCH SYSTEM. BOEING





18 CURE FOR THE COMMON 'RASH'

Boeing engineers worked for years on a process for quick repairs to the composite skin of jetliners after minor damage known as "ramp rash." The easy-to-use kit allows temporary fixes at the gate in about an hour. PHOTO: BOB FERGUSON/BOEING

38 MORE THAN A SALE

Finding global opportunities for growth means Boeing must continue to build strong relationships with governments, customers and suppliers all over the world. It's not just about making a sale. PHOTO: ASSOCIATED PRESS



34 THE GOOD SEED

Thanks in part to Boeing's Global Corporate Citizenship, farmers on the Indonesian island of Bali are producing local organic seed stocks to sell, generate income and improve nutrition. It's also helping the environment. PHOTO: BOB FERGUSON/BOEING

42 HIGH-FLYING ART

Boeing paint shop employees recently customized a Qantas 737 jet with an unusual livery. Other airlines also are requesting Boeing's painting talent for special liveries to emphasize their brand and for special events. JIM ANDERSON/BOEING

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LEADERSHIP MESSAGE

FLIGHT PLAN 2014

Earning our way to customers' loyalty, sustained success

In 2013, Boeing employees around the world worked together to deliver on our commitments to customers and other key stakeholders while overcoming adversity and capturing new opportunities along the way. We achieved record business results, reached major milestones on our key development programs, retired risks, and advanced the product and services strategies that will enable our continued growth and provide jobs and careers for Boeing people for decades to come.

This determined performance has set the pace for 2014 and beyond as we pursue our goal of leading the aerospace industry through our second century of innovation that begins in 2016.

The ingredients of our success these past few years—in re-establishing our clear market leadership in commercial airplanes and in weathering a difficult defense, space and security environment—are the same strengths and strategies we'll need to draw upon to sustain our performance and position in the years ahead.

Fiscal and competitive pressures on our customers are steadily increasing. As a result, their expectations of us and the value we provide have never been higher. Our customers want more capability, more efficiency, more quality and more reliability, all for less money. At the same time, there's a growing global list of high-quality, lower-cost providers of aerospace products and services that our customers can

choose from—and leverage against us—for the best price.

Our brand and reputation have been built upon the quality and performance of the products and services we have provided customers for generations. However, as we have learned through the results of recent competitions on both sides of our business, we are not automatically entitled to sustained success in our markets or the endless loyalty of our customers. We must earn both through the ever-increasing value and competitive advantage our innovation provides them to ensure they succeed in their markets or do their jobs better.

Our existing competitors are as aggressive as our emerging competitors are hungry. Both want to take our market share—and the jobs and prosperity that go along with it—and they are getting better and more efficient to drive their success. This simply means that as good as we are today, we have to keep getting better—and do so faster—to preserve and extend our leadership position.

With large addressable global markets, a record backlog, highly skilled and dedicated people, and competitively superior technologies and products, we are poised for another strong year in 2014—but it won't be easy. In order to address the realities of this “more for less” world, our 2014 business plan includes aggressive goals for continued improvements in first-time quality, productivity, affordability, in-service

reliability, workplace safety and environmental performance.

These goals apply to—and our efforts must focus on—the work done in our factories, offices and throughout our supply chain. Achieving them will challenge us to take all that we have done, and all that we have learned, and build upon it—to do our jobs safely and more efficiently; deliver our products and services on time, on cost and with the reliability we promised; to accept personal accountability for our work and share responsibility for the work of those around us; and to leverage the global strengths and capabilities of “One Boeing,” while adhering to the values and integrity that have long defined who we are as a company.

Inspired by the achievements of 2013, I have the utmost confidence in our team and our future as we chart the course for our second century of aerospace leadership and build a bigger, better Boeing, together. ■

“Our 2014 business plan includes aggressive goals for continued improvements in first-time quality, productivity, affordability, in-service reliability, workplace safety and environmental performance.”

—**Jim McNerney**

Boeing chairman
and chief executive officer



SNAPSHOT

Peak performance

With snow-covered Mount Rainier in the distance, a U.S. Army AH-64E Apache helicopter assigned to the 1-229th Attack Reconnaissance Battalion hovers over the flight line at Joint Base Lewis McChord in Washington state. The AH-64E Apache, built by Boeing in Mesa, Ariz., recently achieved initial operating capability on schedule, and the battalion was the Army's first unit to be equipped with the newest version of the famed attack helicopter. PHOTO: U.S. ARMY





QUOTABLES

“747-8 customers will use roughly 30 fewer trucks of fuel per airplane per year.”

—Eric Lindblad, vice president and general manager, 747-8 program, on the first customer delivery of a new 747-8 incorporating the Performance Improvement Package, which includes improved GENx-2B engines. *Boeing News Now*, Dec. 18

“We’re starting to do whole new ranges of missions that we never even thought of before.”

—U.S. Marine Corps Col. Michael Orr, talking about the capability and flexibility of the Bell Boeing V-22 Osprey tilt-rotor aircraft. He flew a V-22 from North Carolina to Boeing’s Philadelphia site on a visit to thank Boeing employees who help build the Osprey. *Delaware County Daily Times*, Dec. 5

“They know everything is going to be all right when they hear that Apache flying over the horizon.”

—U.S. Army Col. Jeffrey Hager, project manager for Apache Helicopters, on the value of the AH-64 Apache to soldiers in combat, during ceremonies marking initial operating capability of the latest version of the Apache, the AH-64E Guardian. (See Snapshot, left.) *Boeing News Now*, Dec. 1

A man with dark hair, wearing a blue dress shirt and a light-colored patterned tie, is shown in profile, looking thoughtfully to the right. He has a pen in his shirt pocket. In the background, a large clock is visible, showing the time as approximately 10:10. The lighting is soft and natural, suggesting an office environment.

**“The most
challenging
part... is
helping to
distill the
complexity of
our products.”**

—Charles Wanless

WHAT WE DO

MAKING EVERY DAY COUNT

Time has special meaning for this Boeing employee

By Charles Wanless and photo by Jennifer Terrill

Charles Wanless, a Creative and Information Services multimedia designer for the Shared Services Group, supports Boeing Network & Space Systems in Arlington, Va. In this *Frontiers* series that profiles employees talking about their jobs, Wanless explains what drives him to be his best every day.

Like other employees at Boeing, I'm very aware of the value of time.

As a multimedia designer for Boeing Creative and Information Services, I support many of the senior leaders of Boeing Network & Space Systems, creating presentations, videos, 3-D animation and design, and other similar products. I frequently have to juggle multiple projects with shifting deadlines, as the requirements of my customers can evolve, often on short notice.

But for me, time has an added meaning that goes beyond the office. As a two-time cancer survivor and someone who is battling the effects of Parkinson's disease, I know that time is indeed precious.

However, this realization has freed me to pursue my goals with a great amount of passion and drive. Early in my career, I decided I wanted to become an expert in multimedia design and integration. I have been able to gain skills in everything from designing audio-visual systems to doing architectural design to creating glass etching fine art to owning my own multimedia consulting company. I even learned how to train dolphins

and do makeup and visual effects prosthetics for the movies!

Each of these experiences prepared me for my career here at Boeing. Including my time as a consultant, I have worked at Boeing for 20 years. My current assignment in Network & Space Systems allows me to be involved in the creative process for multimedia projects from beginning to end. From discussing the themes and key messages with senior executives and their communicators to designing the presentation, I get to touch every single aspect of the project.

The most challenging part of the process, which is also the most rewarding, is helping to distill the complexity of our products and capabilities into an easily understandable visual product that complements the rest of the presentation.

I love the sense of teamwork and camaraderie that exists. I get to work on some great projects with truly talented executives, subject-matter experts, communicators and Creative and Information Services colleagues, which drives me to do the best I can—because every day counts. ■

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Charles Wanless

HAS WORKED FOR BOEING:
20 years

PRIMARILY WORKS WITH:
Boeing Network
& Space Systems

ORGANIZATION:
Shared Services
Group

HISTORICAL PERSPECTIVE

SHORT HAUL

Commercial promise of Douglas DC-5
passenger plane overtaken by war

By Pat McGinnis



For more on the Douglas "DC" series of airliners,
see story in the December 2010 issue of *Frontiers*.



PHOTOS: (Far left) Douglas mechanics in El Segundo, Calif., perform maintenance checks on the DC-5 prototype. (Above, from top) One of two DC-5s delivered to KLM in Curaçao; the DC-5 prototype; Bill Boeing with his DC-5, a few days before the official delivery in April 1940. **BOEING ARCHIVES**

On a February day 76 years ago, during the lunch hour so employees could watch, the prototype for a new member of the famed “DC” airliner series by Douglas Aircraft took off on its first flight near the El Segundo plant in California, where it was built.

Douglas, a Boeing heritage company, had high expectations for the DC-5 even before that first flight in 1938. But the new airplane, despite several innovative features, was about to be overtaken by world events.

By the time the DC-5 entered service in 1940, World War II was underway. Only five commercial DC-5s, including the prototype, were built, along with seven military versions known as the R3D.

And the prototype itself saw military action, though not before it was converted to an eight-passenger executive transport and sold to Boeing founder Bill Boeing for use as his personal aircraft.

When the DC-5 was born on the engineering drawing boards at Douglas six months before first flight, the company was the leading manufacturer of commercial transports. The DC-3 was in full production, and, along with the DC-2, was servicing medium-range airline routes. Douglas also was developing the DC-4 for transcontinental routes. But in the expanding commercial airplane market, Douglas also saw a need for a short-haul airliner to serve smaller, out-of-the-way communities.

However, the DC-5, which could carry from 16 to 22 passengers, was developed without airline backing. And it had a high wing, which was a significant departure from the previous “DC” series. Other new features included tricycle landing gear and a circular fuselage cross section that enabled easy access to the cargo hold so it could be loaded from the ground without stands or ladders. A flexible interior could be converted to cargo, passenger, sleeper or executive configurations. And the passenger cabin had larger oval windows.

Due to limited production space at its Santa Monica facility, Douglas designed and produced the DC-5 at its El Segundo facility under the leadership of Ed Heinemann, chief engineer. Heinemann later would design the famed Douglas Skyhawk jet fighter.

Douglas received 28 orders for the DC-5—from the Dutch airline KLM; from a domestic U.S. carrier, Pennsylvania Central, which was later incorporated into United Air Lines; from SCADTA, which later become Avianca in Columbia; from British Airways; and from the U.S. Navy and U.S. Marine Corps.

World War II began before KLM, the initial customer, took delivery of its four airplanes. Originally intended for European routes, they were transferred to KLM operations in the Dutch East and West Indies and used to fly refugees to Australia until the Dutch East Indies were overrun by Japanese forces in 1942. One of these DC-5s crashed and fell into the hands of the Japanese, who repaired it and flew it to Japan to be tested and studied.

The three DC-5s that entered service with the U.S. Navy were used as 16-seat personnel carriers. The four for the Marine Corps were designed to carry 22 paratroopers or be used as cargo transports.

Douglas stopped production of the DC-5 because of the war, and the A-20 bomber took its place on the production line.

None of the 11 production airplanes for KLM and the military survives today.

Even the prototype acquired by Bill Boeing was pressed into service by the U.S. Navy and was believed to have been lost off Australia in 1943 due to enemy action.

Boeing had taken delivery of the prototype in April 1940. As part of the down payment, he traded in the Douglas Dolphin that he purchased in 1934. Both aircraft were named Rover.

Unlike the DC-5 prototype, the Dolphin survived and is on display at the National Naval Aviation Museum in Pensacola, Fla. ■

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ENDURING SUPPORT

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Systems Integration

Maintenance & Modifications



GOOD DIRECTIONS

Boeing health care costs still rising, but at a slower rate than expected

By Randy Liss

Four years ago, Boeing's health care costs were like those at many large companies across the United States—soaring like an airliner just after takeoff.

Projections showed the average health care cost per active Boeing employee climbing 7 to 8 percent annually for a total of 24 percent through 2014, with no slowdown in sight. The sky, it seemed, was the limit—and not in a good way.

Today, those costs are indeed rising—but at a slower rate than had been projected in 2010, according to Tony Parasida, senior vice president, Human Resources and Administration. The average health care cost per active employee has grown about 5 percent annually, for a projected total of about 17 percent through 2014.

This deceleration is most evident when comparing projections for 2013 to actual totals for the year, he said. Four years ago, health care was expected to cost the company \$15,177 per employee in 2013. The actual cost: \$13,622, more than 11 percent less than predicted in 2010.

This trend is expected to continue, Parasida said, with health care costs projected to decrease by 1 percent through September 2014.

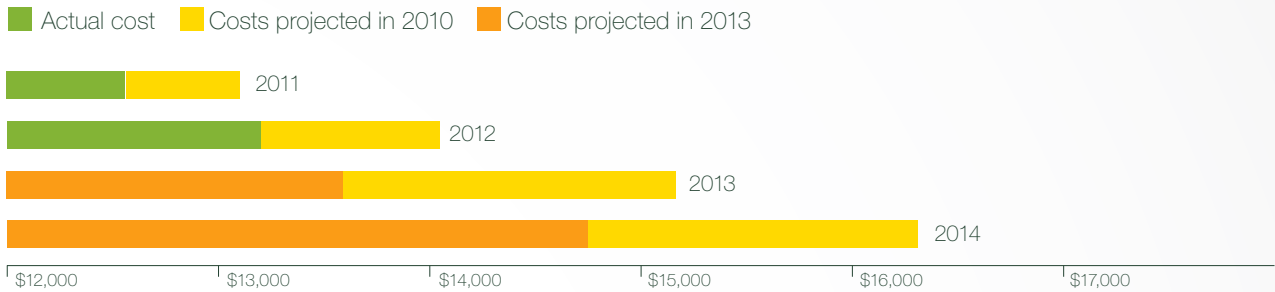
“This is obviously good news for the company and our employees that shows real progress in our efforts to contain health care costs,” Parasida said. “Despite this success, the reality is that costs still are rising. So we’re continuing to look at ways to reduce them while still offering affordable, market-leading health care benefits to employees.”

Company leaders believe that controlling what Boeing spends on health care is essential to sustaining its ability to invest in new products and services, price them to be successful against competitors', create new job opportunities for employees, and attract and retain world-class talent. They're also finding that reducing health care costs is good for business—and for employees, Parasida said.

For example, the company's Well Being programs have combined with the new “Go for Zero” initiative to establish a safe and healthy environment across the enterprise, a culture that can lead to increased employee productivity, Parasida noted.

Meanwhile, the company encourages employees to take more personal responsibility and accountability for sharing health care costs and making health care choices. By researching and understanding their benefit options,

HEALTH CARE COST PER ACTIVE EMPLOYEE



BOEING TOTAL HEALTH CARE COSTS IN BILLIONS



Parasida said, employees become informed consumers and more likely to choose a medical plan that makes the most sense based on their needs, thus lowering costs.

This shared responsibility also includes Boeing’s health care suppliers to ensure that their services enhance employee satisfaction and improve the quality of care while still reducing costs. Parasida said Boeing is seeing progress in these areas as it proactively works with suppliers on continuous improvement.

Helen Darling, president of the National Business Group on Health, sees this comprehensive approach as mutually beneficial for the company and employees.

“Boeing has long been a pioneer, innovator and leader in health care, health benefits and workforce well-being,” Darling said. “Focusing on such areas as safety, productivity, health and employee engagement as a way to improve quality of life and reduce health care costs is a smart strategy that appears to be making a positive impact across the board.” ■

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“Costs still are rising. So we’re continuing to look at ways to reduce them.”

—Tony Parasida, senior vice president, Human Resources and Administration

'NICK' OF TIME

Boeing repair kit offers a quick fix to routine scrapes and dings on composite airplanes

By Eric Fetters-Walp and photos by Bob Ferguson

Just like cars, new airplanes occasionally receive dents and scratches, especially so-called “ramp rash”—minor dings that come mainly from maintenance and airline service trucks at airports. A lightning strike or a hit by a tool also can create nicks and scratches on an airplane, potentially costing an airline hundreds of thousands of dollars in lost revenue while the airplane undergoes repairs.

So it's critical for airlines to be able to repair these quickly.

But what about quick repairs to an airplane with a composite skin? Early on in the 787 development program, potential customers had many questions about the composite skin of the Dreamliner and how routine ramp rash would be addressed.

No worries. Boeing engineers found a way to patch a scratch—at least temporarily—within about an hour. The quick composite repair kit they developed has already proved itself, saving time and money for

airlines that fly the Dreamliner.

“For our airline customers, an airplane out of service for any reason, including damage repair, significantly impacts their operations and customers,” said Mike Fleming, vice president of Services and Support for the 787 program. “Being able to minimize or eliminate this out-of-service time creates value for our customers and for The Boeing Company.”

As of the end of January, more than 115 Dreamliners had been delivered to 16 customers worldwide, and were averaging more than 200 revenue flights per day. More than 10 million passengers have flown more than 90 million miles (145 million kilometers) on the 787 since passenger service began in October 2011.

Any commercial jetliner is taken out of service when serious incidents damage the fuselage skin and require repairs before they can be dispatched. But aviation regulators require that even a small, nonpuncturing scratch or

dent often needs to be repaired so it won't turn into a more serious flaw in the airplane's structure. Such a repair traditionally takes an airplane out of service for days.

And while the 787's composite skin is stronger than the average aluminum airplane skin and is expected to require less long-term periodic maintenance, it's not immune to ramp rash or other mishaps.

That's why engineers from Commercial Airplanes' Commercial Aviation Services and Boeing Research & Technology, a division of Engineering, Technology & Operations, partnered for years to develop a quick way to repair composite materials to provide an advanced fix for the Dreamliner.

Previously, the most common way to fix composite skin damage involved moving the aircraft to a maintenance hangar and using sophisticated cure controllers and heater mats to cure epoxy resins and adhesives in place. The quick repair kit allows minor damage



to be repaired at the gate, with no electricity required, in just a short time.

“This was a big change in the way we repaired airplanes, and many people were skeptical,” said Aydin Akdeniz, a Technical Fellow in Commercial Aviation Services’ 787 Structures Services Engineering group in Everett, Wash. “We knew there had to be a way to do this quickly, within a few hours.”

Akdeniz and other engineers at Boeing for years had considered ways to develop a pre-cured repair patch for composite airplane surfaces. When the 787 entered development, it gave the engineers at Commercial Aviation Services, which supports customers throughout the life cycle of an airplane, a new reason to focus on composite repairs.

Fleming gave his support to the technical challenge after engineers indicated they thought a quick repair process could be developed, said Steve Blanchard, 787 service engineer for Structures and a member of the Commercial Aviation Services team.

“He understood the impact of this for customers,” Akdeniz said of Fleming. “Mike was one of the first champions of support.”

A quick repair patch for composite skins has to do more than cover up a scratch. It has to be strong enough to restore the damaged surface, restore the structure’s load-carrying capability, and seal the defect to prevent further damage until an airline can schedule a permanent repair, Blanchard said.

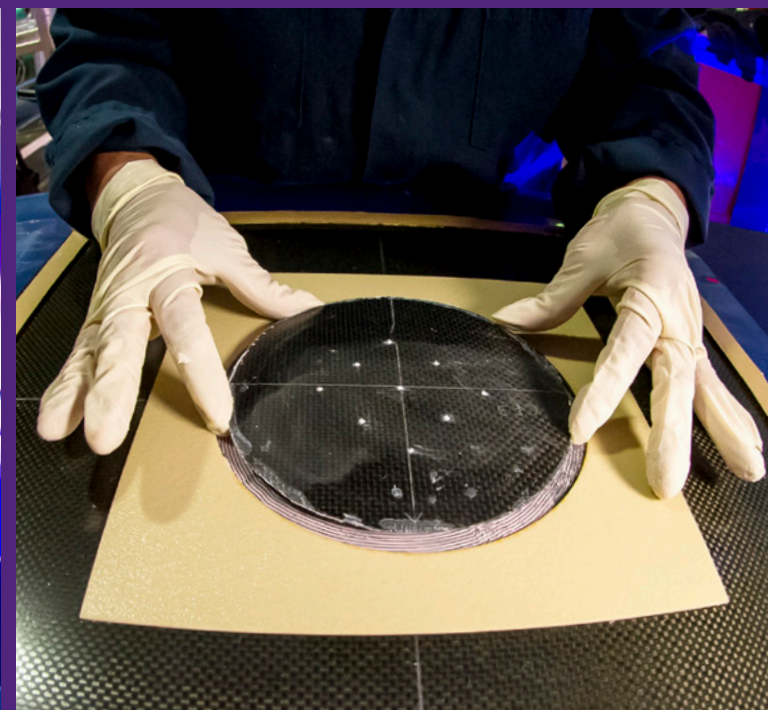
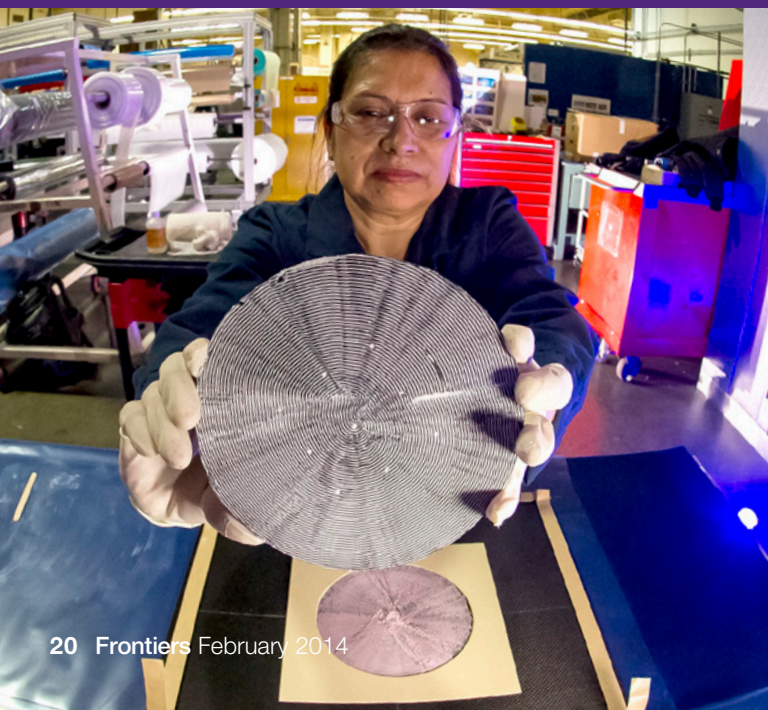
Critical to meeting those criteria was choosing the right adhesive. The team began with 150 candidate adhesives and over time whittled those to 10, evaluating them in laboratory tests during a four-year period, he said. The adhesives were subjected to extreme hot and cold thermal conditions and tested for their shelf life, curing temperatures and bond strength, among other parameters.

“It was a challenge to find an adhesive with the right characteristics,” said John Spalding of Boeing Research & Technology, a Technical Principal and

“This was a big change in the way we repaired airplanes.”

—Aydin Akdeniz, a Technical Fellow with 787 Structures Services Engineering, Commercial Aviation Services

PHOTO: Structural repair technician Mary Vargas, left, and Technical Fellow Russell Keller spread quick composite repair paste onto a test panel in a Boeing Engineering, Operations & Technology lab in Seattle. The two are inside the lab’s large freezer, where engineers tested the quick composites repair process to make sure the adhesive could be applied in cold weather.



Boeing Designated Expert in composite repair who leads the Advanced Composite Repair Lab. "We needed an adhesive that could easily be mixed and applied in hot or cold environments. It had to cure very quickly while still allowing time to apply the patch before hardening."

In one of the most memorable tests, Spalding volunteered to apply various adhesives while standing in a walk-in freezer inside the division's Seattle lab. The eventual quick repair patch solution also was attached to a customer airline's in-service 767 to test its durability in service.

In 2007, the quick composite repair process was qualified as a temporary fix on the 787's primary composite structures. But the Commercial Aviation Services and Boeing Research & Technology team still had to create an easy-to-use kit that would allow airlines to apply the repair patch. Blanchard led a team with representatives from several Commercial Airplanes departments to assemble the quick repair kit, which

contains everything needed for the job. Customer airlines then tested the kits before they were deemed ready for use.

Since last year, airlines have been able to order the quick composite repair kit or any single item needed to replenish the kit. Blanchard said 10 U.S. patents are pending for the kit, while one international patent has been granted.

For its work, the 787 Structures Services Engineering team earned a 2011 Commercial Aviation Services Service Excellence award. But the engineers who worked on the quick composite repair kit are not finished. They continue to work on other variations of the patch repair, Blanchard said.

Meanwhile, customer airlines have purchased at least 75 of the quick composite repair kits for smaller problems, Akdeniz said. Since the 787's entry into service, the composite repair kit has been used a number of times by airlines to quickly repair damage—and help improve dispatch reliability. Repairs incidents have included fixing

dents suffered when airport vehicles hit the airplane to fuselage skin blemishes resulting from severe lightning strikes.

Because of its convenience and relatively low cost compared to taking an airplane out of service, Akdeniz said, airlines are embracing it. ■

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PHOTOS: (Opposite page, top) Aydin Akdeniz, left, a Technical Fellow in Commercial Aviation Services' 787 Structures Services Engineering group, inspects a composite beam used to test the quick composite repair process. In the background, engineers Paul Skinnell, center, and Steve Blanchard inspect repair patches. (Opposite page, bottom left) Structural repair technician Mary Vargas carefully demonstrates how to place the quick composite repair patch (bottom right) onto a test panel after applying adhesive. (This page) Several airlines already have used quick composite repair kits from Boeing to fix minor damage to their composite-material 787-8 jetliners.



FAAR

Boeing's next big adventures into deep space ride with new super rocket

By Bill Seil

It's been more than 40 years since human beings have traveled beyond Earth's orbit. But stay tuned. The next chapter in deep space exploration has begun.

The past four decades have seen tremendous achievements in space. Boeing was NASA's prime contractor for the Space Shuttle program and remains the prime contractor for the International Space Station. The company is also developing a Commercial Crew spacecraft that will carry crew and cargo to and from the space station, as well as other low Earth orbit locations.

The last time astronauts escaped the pull of Earth's gravity was December 1972, when Apollo 17 astronauts Eugene Cernan and Harrison Schmitt became the last people to set foot on the moon.

The Apollo program was made possible by the most powerful rocket ever put into service—the Saturn V. Work on the Saturn's first stage, which was built by Boeing, took place at NASA's vast Michoud Assembly Facility near New Orleans. When complete, it was put on a barge and transported to Cape Kennedy, Fla. Boeing heritage companies North American Aviation and McDonnell Douglas built the second and third stages, respectively.

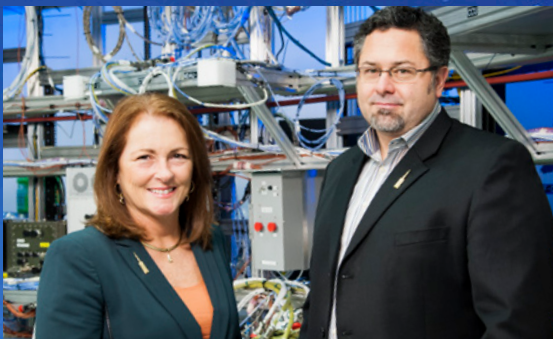
Today a team from Boeing is at Michoud preparing for the construction of the main stage of the Space Launch System, a more powerful and technologically advanced successor to the Saturn V. Boeing is the contractor for the core cryogenic stage, the foundation of the rocket, which is designed to be adaptable to ambitious new missions.

Boeing is also creating the avionics for the core stage, as well as for an interim cryogenic propulsion stage—which is a smaller upper stage that will be used for the first two flights. After these first lunar orbital missions, an interim stage will be replaced by an upper stage to provide additional power needed to travel to deep space.

"Once people realize the capabilities of this vehicle there's going to be great excitement around it," said Todd May, NASA's program manager for the Space Launch System.



OUT



“It’s a great team with a solid base of experience and a passion for the job they’re doing.”

—Ginger Barnes, Boeing vice president and program manager for the Space Launch System program

The evolvable design of the rocket provides the capability to launch astronauts to the moon, asteroids and even Mars.

“It will reignite our imaginations to the possibilities of what human beings can achieve in terms of exploring our nearest neighbors in the solar system,” May added.

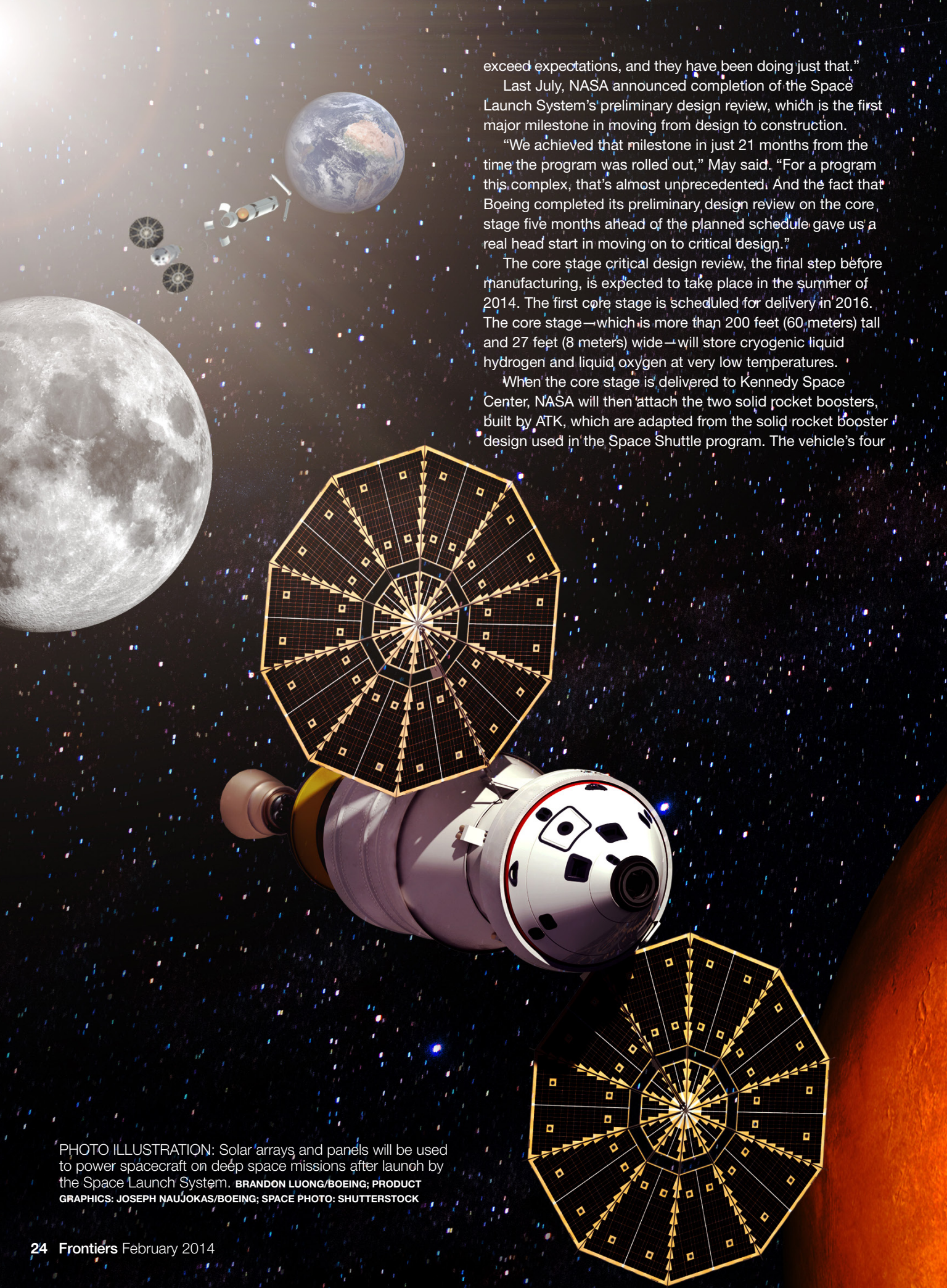
A recent U.S. poll by YouGov Omnibus research found that two-thirds of those surveyed believe humans will set foot on the Red Planet in the next 50 years, and more than two in five believe it could happen in no more than 20 years.

Virginia “Ginger” Barnes, Boeing’s vice president and program manager for the Space Launch System program, said Boeing has a diverse team of approximately 1,300 employees working on the program. Most of them are based in Huntsville, Ala., and there is a growing presence at Michoud.

Others are based in Houston, Cleveland, Southern California and Florida’s Space Coast. The program is also taking a “One Boeing” approach by tapping the talent and experience of people throughout the enterprise.

“It’s a great team with a solid base of experience and a passion for the job they’re doing,” Barnes said. “When I joined the program last year, I was amazed by the amount of work that had been accomplished. They have a spirit that drives them to

ILLUSTRATION AND PHOTOS: (Far left) An artist’s concept of the Space Launch System, or SLS. **BRANDON LUONG/BOEING**; **SLS GRAPHIC: BOEING** (Above, clockwise from top left) Apollo 17 lifts off. **NASA** The vertical weld center at NASA’s Michoud Assembly Facility. **BOB FERGUSON/BOEING** Ginger Barnes, Boeing vice president and program manager for the SLS, and Todd May, NASA program manager for the SLS. **ERIC SHINDELBOWER/BOEING**



exceed expectations, and they have been doing just that.”

Last July, NASA announced completion of the Space Launch System’s preliminary design review, which is the first major milestone in moving from design to construction.

“We achieved that milestone in just 21 months from the time the program was rolled out,” May said. “For a program this complex, that’s almost unprecedented. And the fact that Boeing completed its preliminary design review on the core stage five months ahead of the planned schedule gave us a real head start in moving on to critical design.”

The core stage critical design review, the final step before manufacturing, is expected to take place in the summer of 2014. The first core stage is scheduled for delivery in 2016. The core stage—which is more than 200 feet (60 meters) tall and 27 feet (8 meters) wide—will store cryogenic liquid hydrogen and liquid oxygen at very low temperatures.

When the core stage is delivered to Kennedy Space Center, NASA will then attach the two solid rocket boosters, built by ATK, which are adapted from the solid rocket booster design used in the Space Shuttle program. The vehicle’s four

PHOTO ILLUSTRATION: Solar arrays and panels will be used to power spacecraft on deep space missions after launch by the Space Launch System. **BRANDON LUONG/BOEING; PRODUCT GRAPHICS: JOSEPH NAUJOKAS/BOEING; SPACE PHOTO: SHUTTERSTOCK**

RS-25 engines, built by Aerojet Rocketdyne, were originally designed for the space shuttle. The first launch is expected to take place in 2017. This will lead to the first crewed flight, when astronauts will be launched into lunar orbit aboard the new Orion spacecraft, built by Lockheed Martin.

The biggest challenges ahead for the program to stay on track could be funding by the federal government. Dan Dumbacher, deputy associate administrator for exploration systems development at NASA headquarters, said in a recent interview with *Aviation Week* magazine.

With tight budgets and tight schedules, the use of heritage hardware from the Space Shuttle program has reduced the cost of the Space Launch System and eliminated the need to develop new engines and solid boosters.

“But the coin has two sides,” May said. “The downside of using heritage hardware is that it puts constraints on the design and limits your ability to optimize the vehicle. It’s still a very powerful vehicle, but you can’t fine-tune it as perfectly as you could if you were designing all of the components from scratch.”

One program that gave the Space Launch System—and Boeing—a big boost was part of an earlier space initiative called Constellation. In 2007, NASA awarded Boeing the contract to produce the upper stage of the Ares 1 launch vehicle, which could support beyond-Earth-orbit missions. Constellation, along with Ares 1, was canceled in 2010, but that work laid the foundation for Boeing’s selection on the Space Launch System.

“Because of the progress Boeing had made on Ares 1, it gave us a real running start in designing the core stage of the Space Launch System,” May said. “Much of the avionics design was already in place, and the manufacturing tooling and techniques were already well along.”

Rick Navarro, Boeing’s director of Manufacturing, Assembly and Operations for the Space Launch System, said Constellation was the impetus that got Boeing to rethink manufacturing processes from decades-old manned space programs. New manufacturing and design processes were developed and plans were made to make extensive use of friction stir welding. In addition, the supply chain



LAUNCH ABORT SYSTEM
(Lockheed Martin)

ORION CREW MODULE
(Lockheed Martin)

SERVICE MODULE
(European Space Agency)

ENCAPSULATED SERVICE MODULE PANELS
(Lockheed Martin)

ADAPTERS (Lockheed Martin and
NASA Marshall Space Flight Center)

INTERIM CRYOGENIC PROPULSION STAGE
(Boeing)

LAUNCH VEHICLE
SPACECRAFT ADAPTER
(Contract award pending)

CORE STAGE
AND AVIONICS
(Boeing)

FIVE-SEGMENT
SOLID ROCKET BOOSTERS
(ATK)

RS-25 ENGINES
(Aerojet Rocketdyne)

that had been developed for Ares I was a strong match for the new core stage.

“Constellation is why we’re here,” Navarro said. “When we got started on the Space Launch System, we looked at the Ares I design and really got into the exercise of upsizing the vehicle’s diameter and size. So on several fronts, we were off to a terrific start.”

The selection of Boeing made it possible for the core stage to be built faster and, consequently, keep pace with the development of the Orion spacecraft, which had originated as part of the Constellation program.

While the two-stage Space Launch System will be similar in appearance to the three-stage Saturn V rocket of the 1960s, Navarro said there will be big differences in both the performance of the rocket and the design and manufacturing techniques used to build it.

“Saturn V was designed to go to the moon, and it performed exceptionally well,” Navarro said. “But the Space Launch System will evolve over time and be used on different types of missions. It’s upgradeable. The core stage will serve as the backbone of the vehicle, but new

upper stages and components will be developed over time to meet new requirements.”

After initial test launches, the Space Launch System—when the interim propulsion stage is replaced by a new, more powerful upper stage and advanced boosters are developed—will have approximately 20 percent greater thrust than the Saturn V. Whereas three astronauts flew in Apollo, Orion will carry up to four.

“Physics doesn’t change,” said Charles Dutch, Space Launch System Avionics director. “There will still be a challenging climb through the atmosphere. But we have matured a lot over the past few decades in terms of tailoring our flight profiles more accurately to account for winds and other things we’re going to encounter. Space Launch System will have a lot of redundancies and electronic monitoring systems that give it more autonomy in flight—things that weren’t available in the Apollo era.”

Many members of today’s Space Launch System team are too young to have experienced live television images of astronauts walking on the moon. But they have front-row seats to the next journeys—not only back to the moon but perhaps to Mars and beyond. ■

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PHOTO ILLUSTRATION: Boeing is building the 200-foot (60-meter) core stage and avionics for the Space Launch System. Also shown in this artist’s concept are components produced by industry partners and NASA. **BRANDON LUONG/BOEING**

THE ROCKET MAKERS

With cutting-edge technology, Boeing employees once again are helping build a mighty rocket

By Bill Seil and photos by Bob Ferguson.

Will Walsten, a fabrication specialist who joined Boeing in 2010, is helping build the world's most powerful rocket. It's a challenging task.

At NASA's Michoud Assembly Facility near New Orleans, where both the Saturn V moon rocket and the external tanks for the space shuttle were built, Walsten operates the robotic systems that will be used in advanced friction stir welding to join the huge sections of the new launch vehicle called the Space Launch System, or SLS. In fact, he had a part in developing the friction stir welding techniques that will best meet the needs of the program.

Friction stir welding, a dramatic leap from conventional welding, uses a rapidly rotating pin to generate heat that fuses metallic materials.

"Friction stir welding is the latest, greatest thing in welding," Walsten said. "The welds are considerably stronger and virtually defect-free."

Friction stir welding was not available for use on the external tanks of the space shuttle until the program was coming to a close. And long before the first shuttle flight, the Saturn V had made its last launch.

"I was in awe when I was a little boy and I first saw a Saturn V," Walsten said of the powerful rocket that hurled U.S. astronauts to the moon. "And today I'm in awe of this new rocket and very proud of my part in building it."

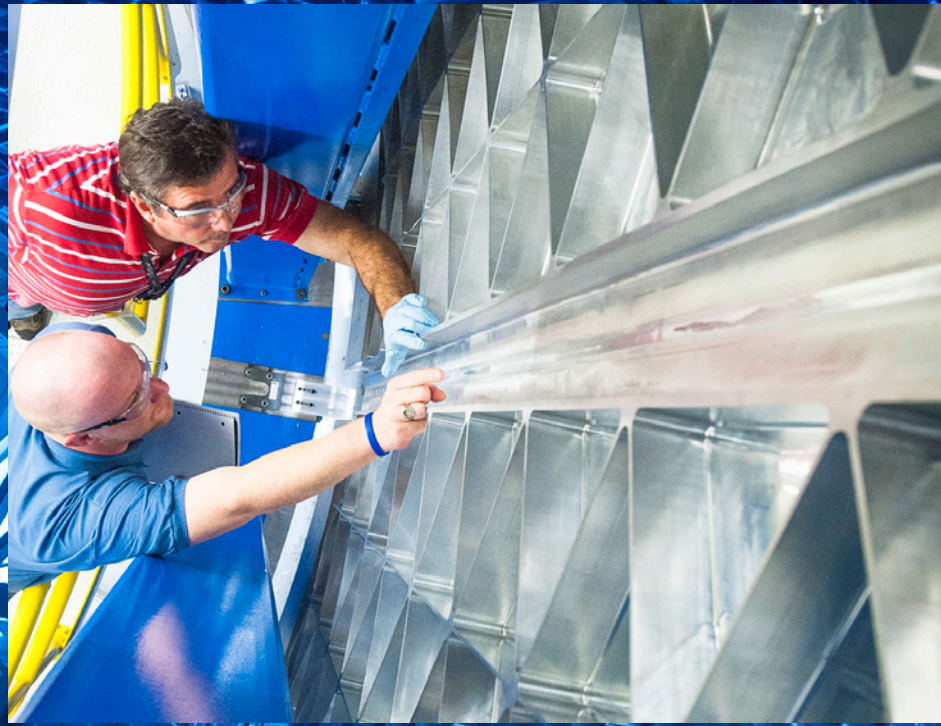
NASA's Space Launch System will be the first rocket in 40 years capable of launching astronauts beyond Earth orbit. Boeing is responsible for building the core cryogenic stage and the avionics system—the backbone and the brains—of the new rocket.

But a lot has changed since the three-stage Saturn V was built in the 1960s, and Boeing's Space Launch System program is forging ahead with a talented, energetic team and cutting-edge design and manufacturing technology.

A vertical weld center has been built at Michoud to friction-stir-weld the panels that will make up the "barrels" of the core stage's two pressurized tanks. Another weld facility will be used to assemble the domes that are placed at either end of the barrels. A 170-foot-tall (52-meter) Vertical Assembly Center, which includes one of the world's largest welding tools, will be used to assemble the full core stage.

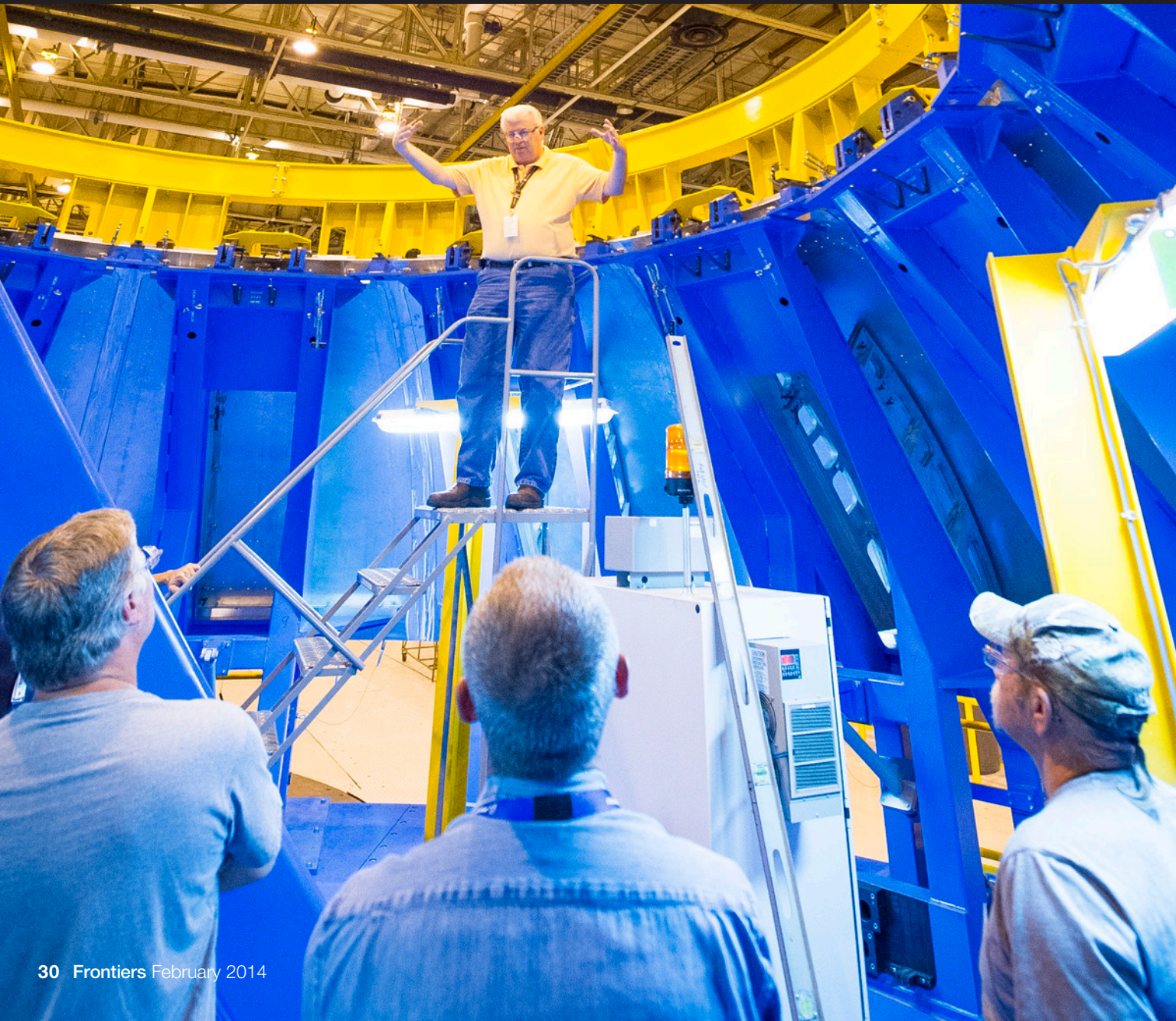
Walsten is also a "lift person in charge" at Michoud, meaning he

PHOTOS: (Insets, clockwise from top left) David White, Fabrication specialist, operates finish machining equipment; Michael Gough, top, Fabrication specialist, and Lennis Conrad, manufacturing engineer, inspect a weld; Fabrication specialists Daryl Smith, left, and Tim Livengood set up to weld on the Segmented Ring Tool. (Right) Safety and quality specialists Mike Sweeney, left, and Jay Schmitt inspect a barrel friction stir weld.



“This is a team effort
and a big ‘One Boeing’
showcase.”

—Rick Navarro, Boeing director of Manufacturing,
Assembly and Operations, Space Launch System



ensures that the right lift fixtures and rigging are used to lift heavy hardware that is critical to the program.

Hinh Hoang, based at Michoud, is one of the younger members of the Space Launch System team. A Manufacturing, Assembly and Operations manager, she ensures day-to-day operations are integrated with other SLS sites and teams. Hoang is also the diversity representative for Michoud and two other sites. She is particularly interested in STEM (science, technology, engineering and mathematics) outreach to students.

“My MBA is in Finance and I always thought I’d end up working for some financial company,” Hoang said. “But I soon discovered that space was my passion and that I wanted to do my part to advance space exploration.”

Kevin Pierre works in electrical and mechanical assembly. His expertise is in electrical installation and test, which involves putting instrumentation, electrical boxes, cameras, fuel and temperature sensors, and other equipment in the core stage. While preparing for the construction of the first launch vehicle, which will be delivered in 2016, he has been assisting with preparation for friction stir welding and thermal protection systems.

“We have a team that’s made up of people from many different backgrounds,” Pierre said. “And everybody’s working together to make the program a success from the very beginning.”

Rick Navarro, Boeing director of Manufacturing, Assembly and Operations for the Space Launch System, said the program has brought in people from other Boeing business units and sought the advice of experts from across the enterprise.

“This is a team effort and a big ‘One Boeing’ showcase,” Navarro said. “We’re getting a lot of technology from the Boeing Research & Technology team. And we have a lot of manufacturing and tooling know-how that’s coming to us from Boeing Commercial Airplanes.”

Rob Stuart, core stage chief engineer, said the program has been working with Commercial Airplanes to replace certain metal parts with composites to save weight. Commercial Airplanes greatly expanded its composites expertise with the development of the 787 Dreamliner.

“We’ve been working with the guys out at El Segundo who build the flight computers for Boeing satellites,” Stuart said. “We didn’t want to develop a brand-new computer, but we wanted the best equipment we could get. They’re doing a terrific job for us and they’re way ahead of schedule. Their hardware is working just great.”

The development of the core stage uses computer-aided design that includes data on every piece of equipment that is used in the vehicle.

“This allows us to do things like reduce the number of development tests we have to perform,” Stuart said. “We can also communicate directly with the supplier base, which is at the point where they are able to accept computer-based models.”

With a program this complex—involving 1,300 direct employees and considerable support from outside the program—coordination is essential.

Paisley Matthews, senior manager of Program Integration for the Space Launch System, said the focus of her team

is ensuring that the program operates on schedule, that everyone has instant access to metrics and performance data. Direct human interaction is an important part of this.

“The fun thing about integration is that you get to work with people across the program and make sure that the various groups are talking to one another,” Matthews said. “It’s important that everyone understands the challenges of the day and what needs to be done to make things happen.”

In this electronic age, there’s a temptation to rely on data and exchanging emails. But Matthews notes that program integration includes building relationships with people throughout the program.

“I tell my team that it’s important that they get up and go find the person they need to speak with,” Matthews said. “If that person isn’t in the city, I suggest that they get on the phone and call them. In a program like this, you need to understand the challenges people face and what they need. You can’t get that so much from an email or a process.”

Agnes Vargas, based in Titusville, Fla., wears two hats in Boeing Space Exploration. Part of her time is spent supporting Paisley Matthews as the Space Launch System’s Program Integration representative in Florida.

In addition, she is the manager of Boeing Space Flight Awareness, an employee motivation and recognition program run by Boeing Space Exploration and NASA. Overall, the program promotes safety and mission success among employees. In part, Vargas encourages employees to practice good safety habits, both on the job and at home. She also enlists the help of astronauts to remind employees that the quality of their work will determine the safety of astronauts on future space missions.

“My role is to make employees feel engaged and together,” Vargas said. “We’re a team and we’ve got to do the best we can because the lives of our astronauts depend on what we do, whether it’s pushing paper or working on flight hardware. Safety is the most critical thing we do.”

Vargas, a 24-year veteran of the Space Shuttle and International Space Station programs, has met many astronauts over the years—going all the way back to the Mercury astronauts of the early 1960s. But a recent announcement by NASA of a new class of astronauts brought out a deep emotional reaction.

“I was just taken aback!” she said. “I was just so jazzed that these young people will be sent on their missions by the Space Launch System, and that we are part of the team that’s making that possible. That’s the future! It really doesn’t get any better than that.” ■

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PHOTOS: (Clockwise from top left) Fabrication specialists Will Walsten, left, and Todd Duhon review data from a vertical weld; Materials specialists Randolph James and Francene “Frankie” Corradetti inspect a circumferential dome weld; Weld Engineer Bill McGee, top, works with fabrication specialists Ron Hindman (foreground, from left), Richard Oramous and Gary Bennett in planning the weld of a dome cap to a dome gore assembly.

Difference makers

St. Louis site employee environmental team started small—but results have been huge *By Patrick Summers and photos by Ron Bookout*

Cheryl Fievet recalls the early days of recycling at the St. Louis site and sometimes has a hard time believing how far the recycling program has come in the past 10 years.

“We started in 2003 with a handful of employees pushing to recycle the plastic soda-pop bottles from vending machines. We thought it was a big step forward just being allowed to move recycling containers indoors from outside in the parking lots,” said Fievet, an industrial engineer with Boeing Defense, Space & Security.

Through persistence, partnerships with the site’s facilities group and support from leadership, the “handful” of employees a decade later is now the Boeing Employees for Environmental Protection, or BEEP, with 250 members. It’s one of the largest teams of environmentally active employees at Boeing.

The St. Louis team is credited with helping establish innovative recycling projects that have helped Boeing reduce its environmental footprint and expand opportunities for employees to recycle and get involved with a variety of environmental activities.

Bryan Kury, St. Louis Site Services manager, said employee engagement played an important role in helping the site support the company’s first five-year environmental targets, set in 2007.

“It’s all about harnessing the power of the engaged and informed employee,” Kury said.

The success of the employees’ efforts can be measured in part by the amount of solid waste the site now recycles—up from 12 percent in 2007 to 67 percent in 2012. The volume of waste sent to landfills has been reduced

by two-thirds. Across the company, almost 80 percent of the solid waste Boeing generated from 2007 to 2012 was diverted from landfills.

The initial push in St. Louis to recycle beverage containers expanded to include other materials such as cardboard, paper, wood, empty paint and sealant containers, Styrofoam, and several types of plastic. About 4,000 pounds (1,800 kilograms) of bubble wrap is recycled each month alone.

The strong interest in recycling enables the team to organize on-site events so employees can bring from home used electronics and household items that are donated to community groups for reuse or recycling. Athletic shoes are donated to Nike for recycling into a surface material used on playgrounds and athletic fields; blankets and





Building a better planet

BY THE NUMBERS

The story of Boeing's environmental improvements in its operations over the past five years, told in part through reductions in categories such as these:

36% less waste sent to landfills

18% less hazardous waste generation

9% fewer carbon dioxide emissions

3% less energy use

2% less water use

The passion and commitment of employees around the company will continue to play a critical role as Boeing implements plans and strategies to meet aggressive new environmental goals, according to leaders of the company's environmental activities.

Boeing is committed to zero growth in the environmental footprint of its operations during a time when much of the company's core business is expected to experience continued strong growth and expansion, said Terry Mutter, Boeing's environmental strategy leader.

"Zero footprint growth doesn't mean we stay where we are—far from it," he said.

Indeed, to achieve zero growth in greenhouse gas emissions and other key environmental measures, such as water use and the amount of nonhazardous waste sent to landfills, "We will need double-digit improvements in efficiency across all of our operations," Mutter said.

Last year, Boeing successfully met its first five-year environmental targets, which included reductions of 9 percent in carbon dioxide emissions, 2 percent in water use, 3 percent in energy use, 36 percent in waste sent to landfills and 18 percent in hazardous waste generation. Employee-led projects were critical to this success, Mutter said.

"We all have an opportunity to make a measurable difference," he said. "Every day, Boeing employees build a better planet by identifying ways to reduce waste, improve processes and drive environmental considerations into their daily work." ■

towels are given to a local animal shelter.

In addition to a monthly newsletter, the team has an internal website and a network of "champions" in nearly every building who monitor recycling containers and serve as employee contacts. But good communications is only one part of the picture, said Alyssa Duarte-Reinagel, a systems manager with Defense, Space & Security who helped launch the site's broader recycling efforts in 2003.

"You need to come with ideas, suggestions and solutions for what needs to be done; you can't just complain about something," she said.

Duarte-Reinagel and other team members say BEEP is an example of how one employee, with persistence and commitment, can make a difference.

"When I hear people say, 'We can't change things,'" she said, "I point to the blue recycling containers all around the site and say, 'Actually, you can.'" ■

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PHOTOS: Clayton Maxwell (top left) recycles bubble wrap at the St. Louis site, where employees have led efforts to collect many items for recycling, including old personal videotapes (top middle) and plastic bottles—even old athletic shoes (near left), which are recycled into a surface material used on playgrounds and athletic fields.



Seeds of



Boeing program is helping farmers on the island of Bali in Indonesia

By Jay Krishnan and photos by Bob Ferguson

Boeing photographer Bob Ferguson recently accompanied Skip Boyce, president, Boeing Southeast Asia, on a trip to Indonesia for a firsthand look at one of the company's many Global Corporate Citizenship programs. On the island of Bali, they visited with local farmers who are learning to become more self-sufficient and better at their trade—with Boeing's help.

Of the 17,000 islands that make up the Indonesian archipelago, Bali is perhaps the best-known, an island paradise that conjures up images of smoldering volcanoes, rice-terraced mountains, paddy fields and a vivid Balinese Hindu culture.

And, of course, there are those inviting, postcard-perfect Bali beaches where the tourists come to soak up the sun.

But Ketut Suratna sees an entirely different side of Bali life. He's a farmer, a resident of Bangli, one of Bali's poorer districts tourists usually don't visit.

He became a farmer out of necessity—to feed his family and eke out a meager living.

"Many of the villagers here depend on farming for a living," Suratna explained as he showed a small group of visitors the farm plot where he toils daily to produce crops such as eggplant and chili under hot and humid conditions.

"Farmers like me have been struggling in recent years because we cannot afford to buy seeds," Suratna said. "The use of chemical fertilizers and pesticides is also costly and poses health risks to us."

That's where Boeing is helping, through its

PHOTO: Farmers in Bali collect sweet basil seeds.

HOPE





Global Corporate Citizenship programs.

Since November 2012, Boeing has sponsored a project known as “Saving Indigenous Plants—Seed Saving Partnership with Bangli Farmers.”

The project is administered through the IDEP Selaras Alam Foundation.

A local nongovernmental organization with the Indonesian Development of Education and Permaculture, or IDEP, the foundation was established in 1999 to promote what it calls the “Cycle of Resilience.” Organic farming features prominently within this framework and the foundation works closely with local farmers to educate and train them on the use of renewable farming techniques to achieve long-term sustainability.

Suratna and nine other farmers from the Bangli district are included.

Seed saving is a traditional farming practice of organically growing and preserving indigenous plant seeds in their original form for use from year to year, as opposed to purchasing seeds each

year from commercial seed suppliers that might be genetically modified.

Apart from training the Bangli farmers on sustainable and organic seed production, the foundation assists them in the packaging, marketing and sale of these seeds across Bali.

The Bangli farmers have so far produced more than 15 plant seed types ranging from beans to cucumber, eggplant, lettuce and tomatoes, according to the foundation project coordinator, Nyoman Sudiana.

“It’s a simple but powerful concept,” Sudiana explained. “We produce local organic seeds, which are then sold and spread across the island of Bali. This generates income for the farmers and the markets that sell the seeds. Meanwhile we’re promoting the goodness of growing and consuming organic food.”

Skip Boyce, president, Boeing Southeast Asia, visited with the Bangli farmers last year to see their progress firsthand.

“When we sat down with them in the fields their faces expressed gratitude,” Boyce recalled. “It conveyed how the Boeing Global Corporate Citizenship program has helped empower the lives of these otherwise struggling farmers with the knowledge and tools they need to establish a steady source of income to improve their quality of life.”

For Suratna, with this empowerment comes a renewed sense of pride in being a Balinese farmer.

“Before, I worried each day if there was going to be enough food on the table for my family,” Suratna said. “Now, I hope we Bangli farmers have sowed the seed of inspiration in fellow farmers near and far so that they, too, will consider organic farming to help protect our environment and livelihood.” ■

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PHOTOS: (Far left) Ketut Suratna sifts dried pea seeds. (This page, clockwise from top left) Seeds produced by local farmers are sold at a Bali cafe; Ketut Suarjana, left, a Bangli farmland owner, and Skip Boyce, president of Boeing Southeast Asia; Bangli farmers de-seed an eggplant; Sabaruddin, staff member at the IDEP Selaras Alam Foundation.



GOOD CHEMISTRY

How one small company in Australia became part of the Boeing supply chain underscores the importance of finding opportunities to grow the company's international business—and build relationships *By Jaimié Cardé*

It was not too long ago that a small company in Melbourne, Australia, was specializing in nickel plating for industrial tooling that produced keys, doorstops and refrigerator door handles.

Today, that same company, Electromold Australia, is part of the supply chain for some of Boeing's most advanced aircraft, including the 787 Dreamliner and the F/A-18 Super Hornet.

"To be such a small company, but knowing we play a part within such a large global network, is a real motivator for our team," said Steve Harvey, chief executive officer of Electromold.

How the Australian company of fewer than 25 employees became involved with an aerospace company the size of Boeing underscores the work done around the world by the International Strategic Partnerships team within Boeing Defense, Space & Security.

Building global relationships and partnerships, while growing international sales, is a key strategy for Defense, Space & Security—and for all of Boeing. And International Strategic Partnerships is the organization that works across Boeing's businesses to find opportunities and companies to work with that will help meet the long-term needs of Boeing and its partners. That involves working with local governments and industry around the world to find companies such as Electromold that not only can help Boeing and its suppliers but can in the process strengthen the local aerospace industry.

"Our customers want to know that Boeing is about more than just making a sale; they want to know that we will be around for the long term," said Gwen Kopsie, director of International Strategic Partnerships.

In Australia, the International Strategic Partnerships team, known as the Office of Australian Industry Capability, has worked closely with the government and industry to build capability and capacity in the country's aerospace industry, particularly suppliers. The establishment of the Office of Australian Industry Capability in 2007 marked a significant shift from traditional prescribed industrial commitments to a true partnership: a demonstration of

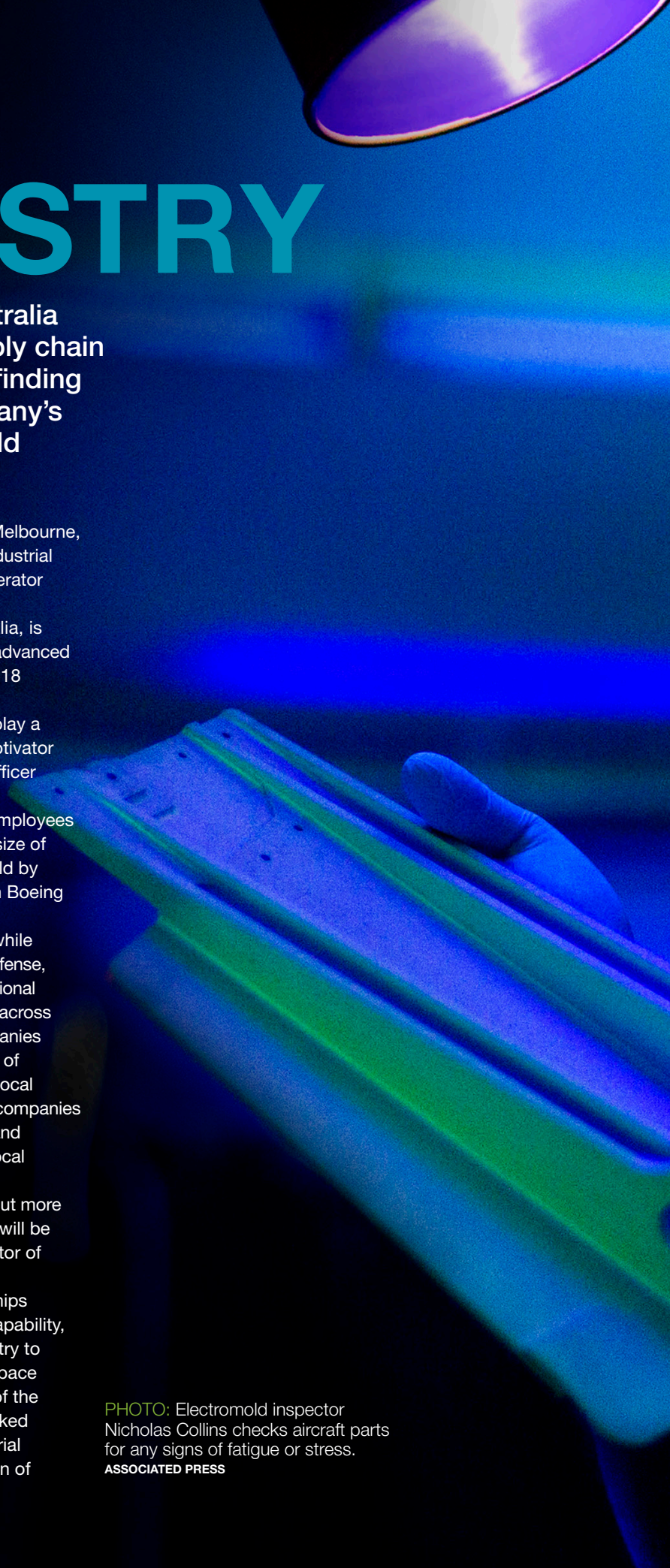
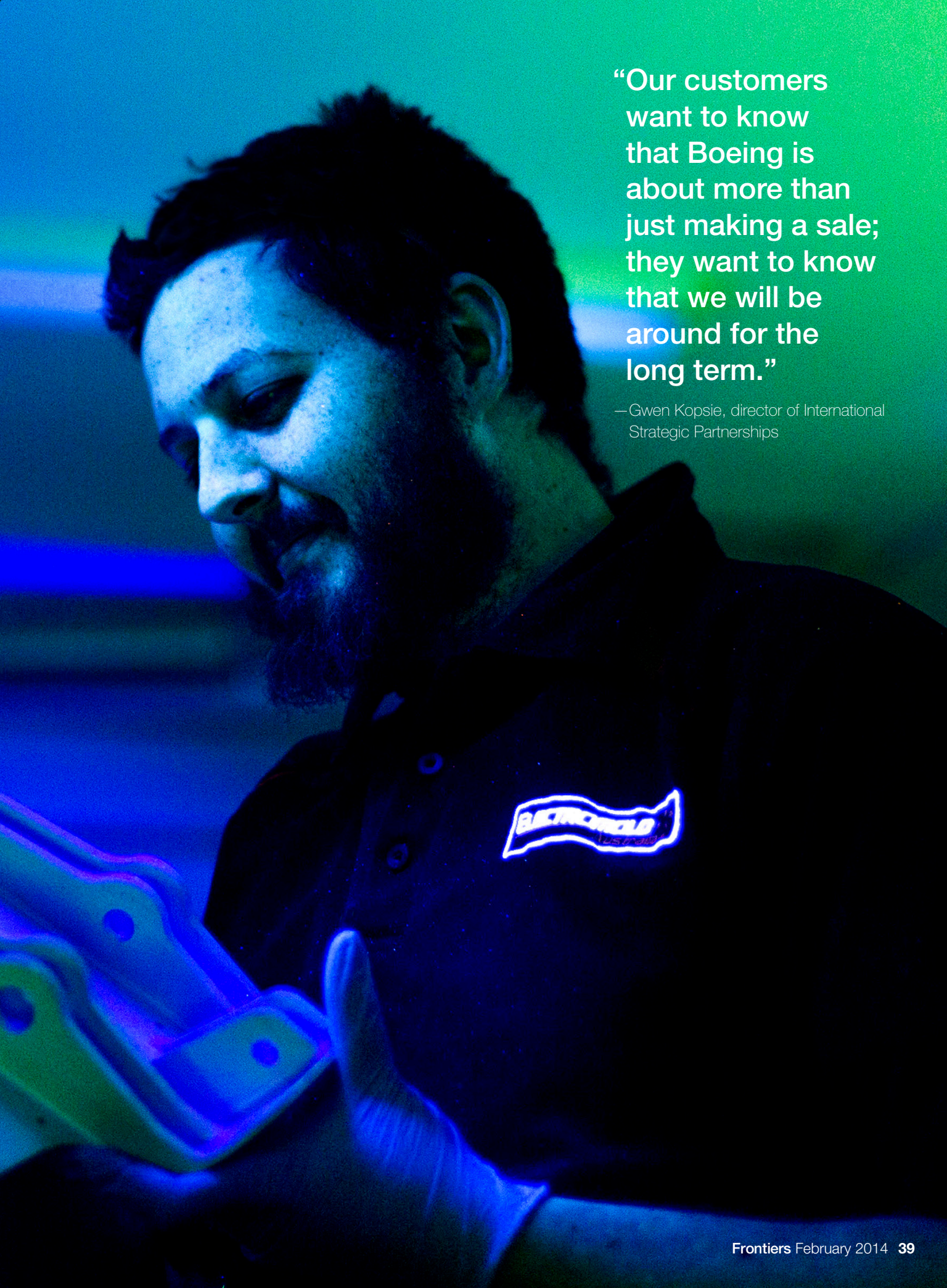


PHOTO: Electromold inspector Nicholas Collins checks aircraft parts for any signs of fatigue or stress.
ASSOCIATED PRESS



“Our customers want to know that Boeing is about more than just making a sale; they want to know that we will be around for the long term.”

—Gwen Kopsie, director of International Strategic Partnerships



PHOTOS: (Insets, from top) A primed Boeing airframe part is ready for final inspection; a 787 component for the outboard flap. Shown in the background are 747 fittings being prepared for a surface treatment. **ASSOCIATED PRESS**

Boeing's commitment to Australia, Kopsie said. "We've been able to demonstrate our engagement as a trusted local partner for not only defense but also commercial programs and areas of technology research," said Dean Webb, program manager for the Office of Australian Industry Capability.

When Boeing's Australia team examined the supplier network there for opportunities, Webb explained, they found a notable inefficiency. There was no Boeing-certified supplier in the country that specialized in the chemical surface treatment of aircraft parts—a process that treats the metal surface to chemically enhance their performance capability. So parts had to be shipped from Australia to the United States for treatment, then shipped back to the supplier in Australia for completion. The completed parts would be shipped to the United States a second time.

Electromold had the chemical treatment capability, but it was not certified by Boeing.

Starting in 2011, the Australian company worked directly with the Office of Australian Industry Capability to streamline its operations and then pass an exhaustive approval process. Today, Electromold has multiple contracts from Boeing's direct suppliers, and is processing commercial and defense parts that go into Boeing products such as the 787 Dreamliner, V-22 Osprey and F/A-18 Super Hornet.

And the company is getting noticed locally for being a valuable link in Boeing's supply chain—recognition that highlights Boeing's commitment to being a good local partner.

Harvey, Electromold's chief executive officer, recently spoke with a reporter for a local newspaper about the work his company is doing for Boeing suppliers.

"If you are sitting in a Boeing 737 and look out at the wings and see the flaps, then we have worked on the hinge that works that flap," he said, adding: "We have parts that hold bombs in place on the most advanced defense aircraft."

While not every company the International Strategic Partnerships team works with will become a direct or indirect Boeing supplier, building relationships within the larger supply network has been critical, according to Kopsie.

"Moving beyond the perceived traditional supplier relationships," Kopsie said, "Boeing continues to leverage our partnerships to find the next innovative technology." ■

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CUSTOMER PROFILE

Scooting into the future

Singapore-based airline will expand long-haul, no-frills service with 787s

By Tim Bader



As the name might suggest, Scoot is an airline that has embraced spontaneity, movement, informality—and a touch of quirkiness.

“These attributes are personified in a unique spirit that encapsulates our value and style,” said Campbell Wilson, chief executive officer of Singapore-based Scoot. “It is apparent to our guests whenever they interact with us. An airline with a different attitude. People with a different attitude. What we call ‘Scootitude.’”

Scoot, whose parent company is Singapore Airlines, is using this culture and a no-frills, low-fare business model to serve medium- and long-haul routes in the fast-growing Asia-Pacific market. The airline, which began operations in mid-2012, entered the market at the perfect time.

“The Asia-Pacific economies continue to exhibit strong growth,” said Dinesh Keskar, senior vice president of Asia Pacific and India Sales, Boeing Commercial Airplanes.

“Air traffic in the region over the next 20 years is projected to grow 6.3 percent per year. The timing and the market

conditions are right for Scoot.”

To support Scoot’s growth, it is looking to the Boeing 787 Dreamliner. The airline announced in October 2012 that it will take delivery of 20 Dreamliners starting in 2014. Scoot will be one of the few low-cost carriers to own and operate 787s.

To date, Scoot has carried more than 2 million passengers and maintains an average load factor of just over 80 percent. It also has expanded its network to 13 destinations and grown its head count to about 520.

The budget market has grown dramatically over the past 10 years and is expected to continue growing, Keskar noted.

The 787s come to Scoot through Singapore Airlines, which originally placed the order for the airplanes. The 787s will replace Scoot’s 777-200s, and help the airline’s ongoing expansion. Meanwhile, the 777s will help power NokScoot, the new Bangkok-based medium-haul, low-cost airline Scoot is starting in partnership with Nok, a Thai-based low-cost carrier and existing 737 operator.

Scoot will use the 787s to launch new routes as well as bump up frequencies on existing ones, Wilson said. This will enable Scoot to broaden its network.

“The Boeing 787 will power our growth and be great for our guests—not least because the aircraft’s fuel efficiency will help keep ticket prices low,” Wilson said.

Much of the growth, according to Wilson, is expected to come from the “economic sweet spot”—destinations that are between five and nine hours away in countries such as China, India, Australia, South Korea and Japan.

“It is an exciting time for Scoot,” agreed Boeing’s Keskar. “We look forward to working with them and helping them for years to come.” ■

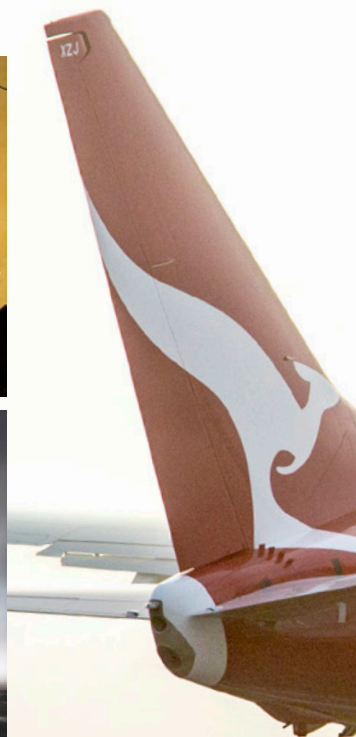
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GRAPHIC: Singapore-based Scoot will support growth with 787 Dreamliners.
BOEING

Taking art to **ne**

Airlines are requesting more custom liveries, and Boeing paint teams love the challenge

By Dawsalee Griffin



After more than a year of planning, a 737 rolled into the Renton, Wash., paint hangar last fall to begin a metamorphosis that would test the skill and patience of two dozen Boeing airplane painters.

The airplane was factory-fresh, or “green,” its unpainted aluminum body wrapped in protective coating. In five days it would sport a unique paint job based on a revered artwork that hangs in the National Gallery of Australia.

The special livery for this Qantas 737, which the airline has named *Mendoowoorji*, was created by Balarinji Design Studio, which based the image on the late West Australian Aboriginal artist Paddy Bedford’s 2005 painting “Medicine Pocket.” Qantas, Australia’s national carrier, calls it “a flying tribute to the world’s oldest continuing culture.”

“It not only reflects our rich history as a country,” said Alan Joyce, Qantas CEO. “It highlights the opportunities we have to promote our indigenous culture to the Australian public and our international visitors.”

While custom liveries aren’t new, the Renton site saw an uptick in 2013, according to Commercial Airplanes paint managers.

“We typically do six to 10 special liveries a year. In 2013, we did

14,” said Carl Holtmann, Paint senior manager for the 737 program.

The Everett site also does custom liveries, but it does not break them out in its records; they are lumped into a broader category of paint jobs that take more than four days to complete.

Airlines generally commission special paint jobs as part of their brand strategy, using them to communicate around topics of interest in their markets, said Fariba Alamdari, vice president of Marketing for Boeing Commercial Airplanes. Custom liveries celebrate milestones, national history, sporting events, new routes and even movie premieres, she said. For example, Air China painted a 737 with Beijing Olympics mascots to signal its role as official airline of the 2008 games.

Air New Zealand’s fleet includes several all-black air-

PHOTOS: (Insets, clockwise from bottom left) Boeing painters Eric Klug, from left, team leader Steve Hoye and Anthony Kakalecik examine a 737 paint test panel; teams from Boeing, Qantas and Balarinji Design Studio meet before painting begins; plans for a special livery. **JIM ANDERSON/BOEING** Air New Zealand’s “All Black” 777 commemorates the airline’s partnership with the country’s rugby team. **AIR NEW ZEALAND** (Far right) *Mendoowoorji*, a Qantas 737 in livery inspired by the Aboriginal painting “Medicine Pocket,” takes off from Boeing Field in Seattle. **JIM ANDERSON/BOEING**

w heights



planes—a nod to its partnership with New Zealand Rugby and the World Cup championship team, the “All Blacks.” One, a 777-300ER (Extended Range), is the largest all-black airplane in the world, according to the airline, which also has two *Hobbit*-themed 777s in its fleet.

“Although there is some additional expense and effort involved in commissioning a special paint job or applying an enormous decal, we view these special aircraft as flying billboards—taking our brand to the world in a very unique way,” said Jodi Williams, head of Global Brand Development. “These special liveries have generated worldwide social media and regular media coverage for Air New Zealand.”

For Qantas, its “Flying Art” paint schemes, including the one for *Mendoowoorji*, celebrate the country’s indigenous population.

“We’ve tried to keep this design true to the original artwork,” said Clinton Twist, senior projects engineer for Qantas.

To adapt the artwork to the 737’s bumps and contours, Qantas teamed with Balarinji Design Studio, the Bedford Trust, the National Gallery of Australia and Teague, a firm that works with Boeing to design airplane liveries and interiors.

Applying any 737 livery—standard or customized—requires

eight painters per shift, with Boeing teams working around the clock and coordinating closely. Work typically begins late at night. Standard 737 liveries can be completed in three days; specialized jobs may take twice that long. Twin-aisle airplanes take longer to paint because of their sheer size.

First painters sand and remove the green protective coating, using fire hoses to clean the airplane. They mask, prime and paint the initial color on the fuselage, fin and engines. This typically takes a day.

On days two through five, painters map the design with templates and apply the paint, one section at a time. For the Qantas 737, Boeing painters used 140 vinyl and Mylar stencils to reproduce the design’s abstract blocks of black, white, red and pale gray surrounded by oval dots. A standard 737 design uses about 40 stencils.

Before touching the airplane, the teams used spare 737 panels to test colors and design elements. They knew that creating the look and texture of brush strokes was critical—and not easy, since the paint is sprayed on.

“We do the most complicated areas last—like fades and creating the brush strokes,” said Steve Hoye, decorative

PHOTOS: (From top) A Southwest Airlines 737 in basketball-themed livery by Boeing. **BOEING** An Air China 777-300ER (Extended Range), painted last July. **PATRICK RODWELL/BOEING** An Air Canada 777-300 in Vancouver 2010 Winter Olympics livery. **TIMOTHY STAKE/BOEING**



painter on the 737 program. “We’re also using a brand-new technique to create the brush strokes.”

The team taped three varnish brushes together to create a footwide brush that they drew across the painted surface to get the effect the airline wanted.

On day five the painting was done. *Mendoowoorji* was ready for its unveiling.

The airplane, for use on domestic routes, was delivered from Seattle in November, with Bedford’s daughter and Aboriginal elders in attendance.

“They did an amazing job,” said Twist, the senior projects engineer for Qantas.

“It’s a challenge to do a livery like this,” Hoyer said, speaking for the entire 24-person Boeing team that worked on *Mendoowoorji*. “We’re proud to have done it right.” ■

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Fish tale

Alaska Airlines, widely known for its creative paint jobs, partnered with the Alaska Seafood Marketing Institute in 2005, and again in 2012, to produce one of the most ambitious liveries in memory.

Unveiled in October 2012, the livery, known as Salmon-Thirty-Salmon II, transformed a 737-800 into a shimmering Alaska king salmon, airbrushed in 21 colors and sporting nearly 3,500 iridescent fish scales. Designed by wildlife artist Mark Boyle and painted by Associated Painters of Oklahoma City, the livery was intended to highlight the state’s role as a leading provider of fresh seafood—and the airline’s role in zipping the catch to North American markets.

“Our Salmon-Thirty-Salmon is one of the most intricately painted aircraft in the world, and it beautifully spotlights the important partnership between our airline and the seafood industry in the state of Alaska,” said Marilyn Romano, Alaska Airlines’ vice president for the state of Alaska. ■

PHOTO: Alaska Airlines’ “Salmon-Thirty-Salmon II,” painted by Associated Painters, transformed a Boeing 737-800 into a shimmering salmon. **ALASKA AIRLINES**

MILESTONES







IN FOCUS

FANTASTIC FOUR

A U.S. Navy F/A-18F Super Hornet rolls after takeoff from Naval Air Station Patuxent River in Maryland last fall, the first time four Harpoon missiles were mounted on the wings of the Super Hornet and tested in flight. The Harpoon is an anti-ship and land-strike weapon that can be launched from aircraft, ships, submarines or by mobile coastal defense vehicles. Boeing builds the Super Hornet and Harpoon missile in the St. Louis area. PHOTO: FRED TROILO/BOEING



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