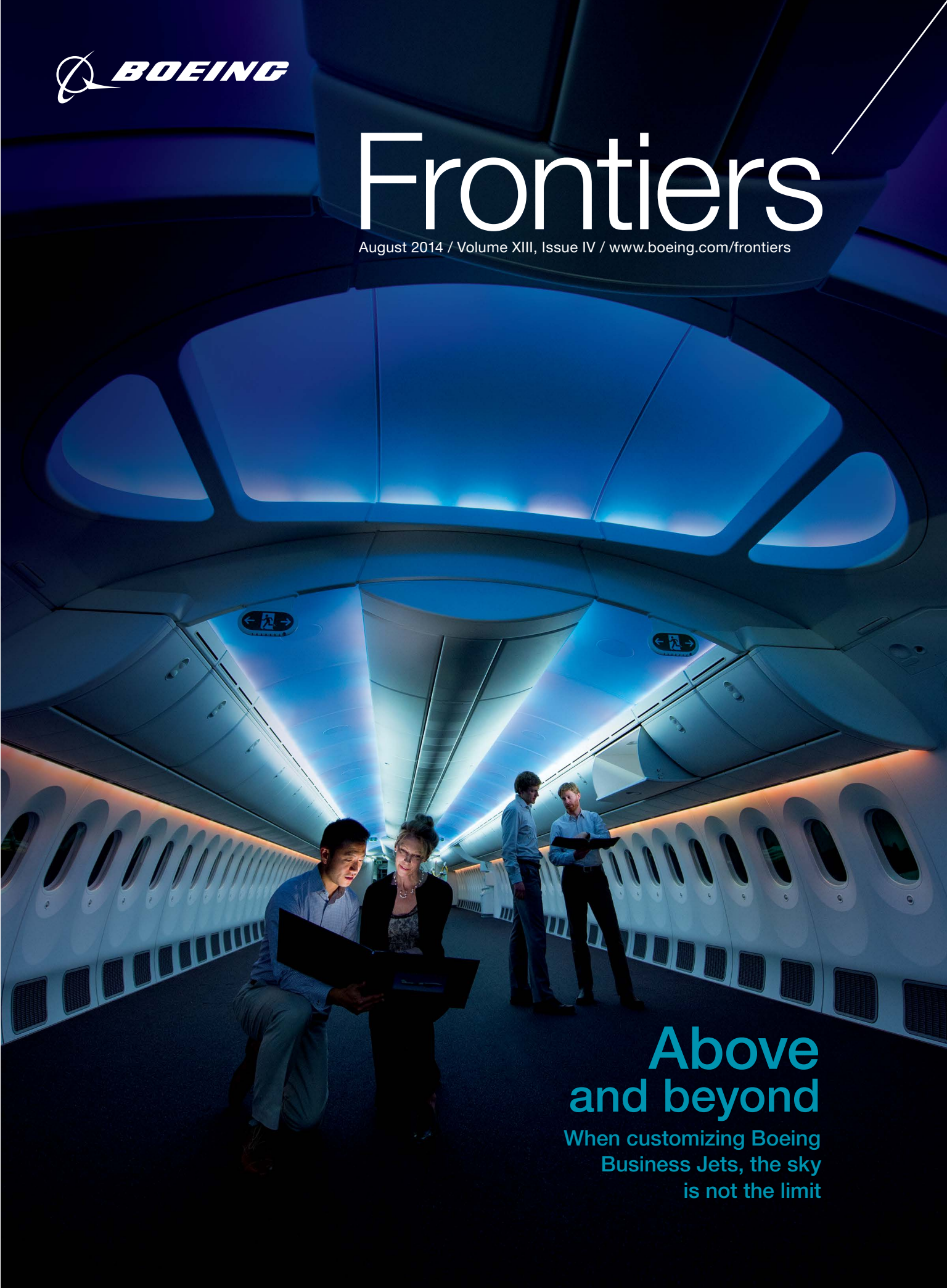




Frontiers

August 2014 / Volume XIII, Issue IV / www.boeing.com/frontiers



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and beyond**

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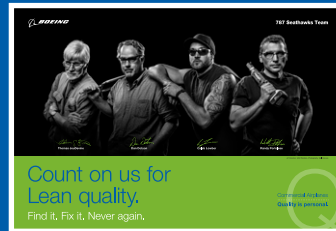
This ad recognizes the U.S. Missile Defense Agency and Boeing-led industry team for achieving a successful intercept test with the Ground-based Midcourse Defense system. The ad is running in political and military trade publications.

06



This recruitment ad, showcasing the Phantom Eye high-altitude, hydrogen-powered unmanned aircraft, emphasizes how an employee pursuing a career at Boeing can help “build something amazing.” It primarily will run in career fair program guides at recruiting, diversity and college events.

12-13



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

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Part of Boeing’s Middle East “Together” campaign, this ad supports Boeing’s commitment to education in the United Arab Emirates. Translated the text reads: “Together we nurture. Boeing supports nonprofit organizations and universities dedicated to nurturing Emirati youth and developing future leaders. Leading through partnership.”

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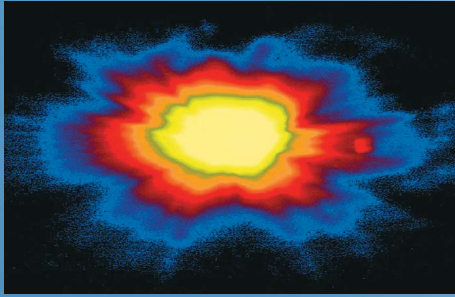
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FSC LOGO



Thermal image of the successful GMD intercept of a threat-representative target, June 22, 2014.



PROVEN, READY AND ABLE.

On June 22, 2014 the U.S. Missile Defense Agency and the Boeing-led industry team completed an end-to-end systems test that resulted in the successful intercept of a threat-representative target. This intercept once again demonstrates the operational capability and readiness of the Ground-based Midcourse Defense (GMD) System, America's only defense against the growing threat of long-range ballistic missiles.



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Whether it's a Next-Generation 737 or a more spacious 777, 787 or 747-8, Boeing Business Jets are meeting heads of state and private-jet owners' needs for the ultimate in travel comfort and convenience, including opulent staterooms and even onboard movie theaters. In serving the needs of this discerning clientele, the BBJ team routinely handles unusual engineering challenges such as installing an interior wall made of plants or adding a huge, customized window.

COVER: Bryan Lung (from left), Amy Wisch, Drew Gough and Anders Brown on board a Boeing Business Jet, or BBJ, 787 shortly after factory rollout. **BOB FERGUSON/BOEING**

PHOTO: BBJ team members Gough (from left), Lung, Carlos Horan and Brown meet in the conference room on board a BBJ, a modified 737-700. **BOB FERGUSON/BOEING**





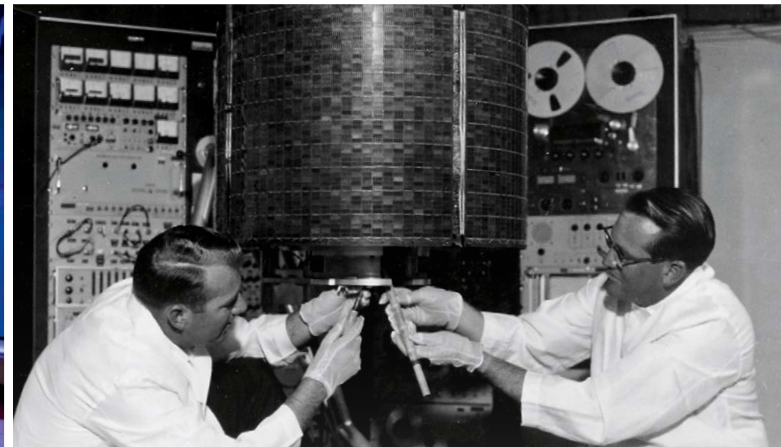
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Over Edwards Air Force Base in California, Boeing's Phantom Eye, powered by engines that burn hydrogen and produce only water as a byproduct, is opening new possibilities for high-altitude, long-endurance flight by an unmanned aerial vehicle. PHOTO: BOB FERGUSON/BOEING



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Employees on Immersive Development teams are connecting people, tools and processes for a common goal—while speeding innovation, boosting performance and reducing costs. PHOTO: BOB FERGUSON/BOEING



40 HISTORICAL PERSPECTIVE

Fifty years ago, the International Telecommunications Satellite Consortium, or Intelsat, was formed and "live via satellite" became a reality. Boeing-made satellites have played a starring role. PHOTO: NASA

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LEADERSHIP MESSAGE

Larry Edwards

Vice president, Site Services, Shared Services Group

Setting the 'stage'

Site Services team has critical role helping Boeing grow

As Boeing prepares to enter its second century, the Site Services team is playing a vital role in positioning the company for future success. Yet the work performed by the 4,000 men and women of Site Services, part of the Shared Services Group, often occurs in the background. It's a role we refer to as being the "stagehands" for Boeing, enabling our commercial, defense, space and security teams to take center stage in the pursuit of turning aerospace dreams into reality.

The bulk of our services are focused on ensuring the smooth daily operation of The Boeing Company. We do this primarily through construction and workspace modifications, team rearrangements, building and equipment maintenance, and real estate transactions.

By doing what we do best—providing employees with these services safely, effectively and affordably each day—our colleagues all across Boeing are free to focus on what they do best. It's in this context that we serve as enablers for our business partners.

But there are times we find ourselves on center stage alongside the businesses. Now is one of those times. Our business partners are simultaneously preparing for future growth and repositioning their businesses to meet emerging market demands. As a result, Site Services has the privilege of performing to a \$3 billion annual operating plan as we help our partners achieve their objectives.

The work our teams are executing on their behalf is unprecedented. Disruption-free choreography is required throughout, mandating close coordination and alignment with all site tenants.

In support of Commercial Airplanes, our Major Projects teams are coordinating a number of significant infrastructure investments, including plans to further boost 737 production rates, which are already the highest ever, while simultaneously introducing the 737 MAX, supporting the P-8 maritime patrol aircraft, and adopting new manufacturing technologies.

And for the new 777X program that is now underway, early milestones include moving several thousand people,

demolishing multiple buildings, and commencing construction on a new Composite Manufacturing Center to build the massive 777X wings, all on a very tight deadline.

And Boeing South Carolina operations continue to expand in support of the business objectives of both Commercial Airplanes and Engineering, Operations & Technology, pulling on our Real Estate and Construction teams.

Facilitating the expansion of Boeing's international presence also engages our Real Estate and Construction teams as we execute lease agreements and build what's required, where required, anywhere in the world.

Within Defense, Space & Security, we are engaged in efforts supporting the closure of the Wichita site in Kansas and a substantial realignment in Southern California, including preparing for the upcoming closure of the C-17 production facility in Long Beach.

At Site Services, we know it's imperative that we deliver on our commitments without disruption to your workplace, safety, security, efficiency or costs. Our performance affects your performance—and, ultimately, the company's future growth and success. Our commitment to you, and our business partners, is one we do not take for granted or take lightly. We're there for you, we're there with you—even though we may not be "center stage." ■

PHOTO: MARIAN LOCKHART/BOEING



SNAPSHOT

Dream landing

The newest member of the Qantas Group fleet, a Jetstar 787, lands after a pre-delivery flight at the Everett, Wash., site in early July. It was the fifth 787 Dreamliner delivered to Jetstar, a wholly owned subsidiary of Australia's Qantas. The landing helped mark 55 years of Boeing jet service for Qantas, a history that began when the airline received its first 707. PHOTO: SCOTT COLLINS/QANTAS



QUOTABLES

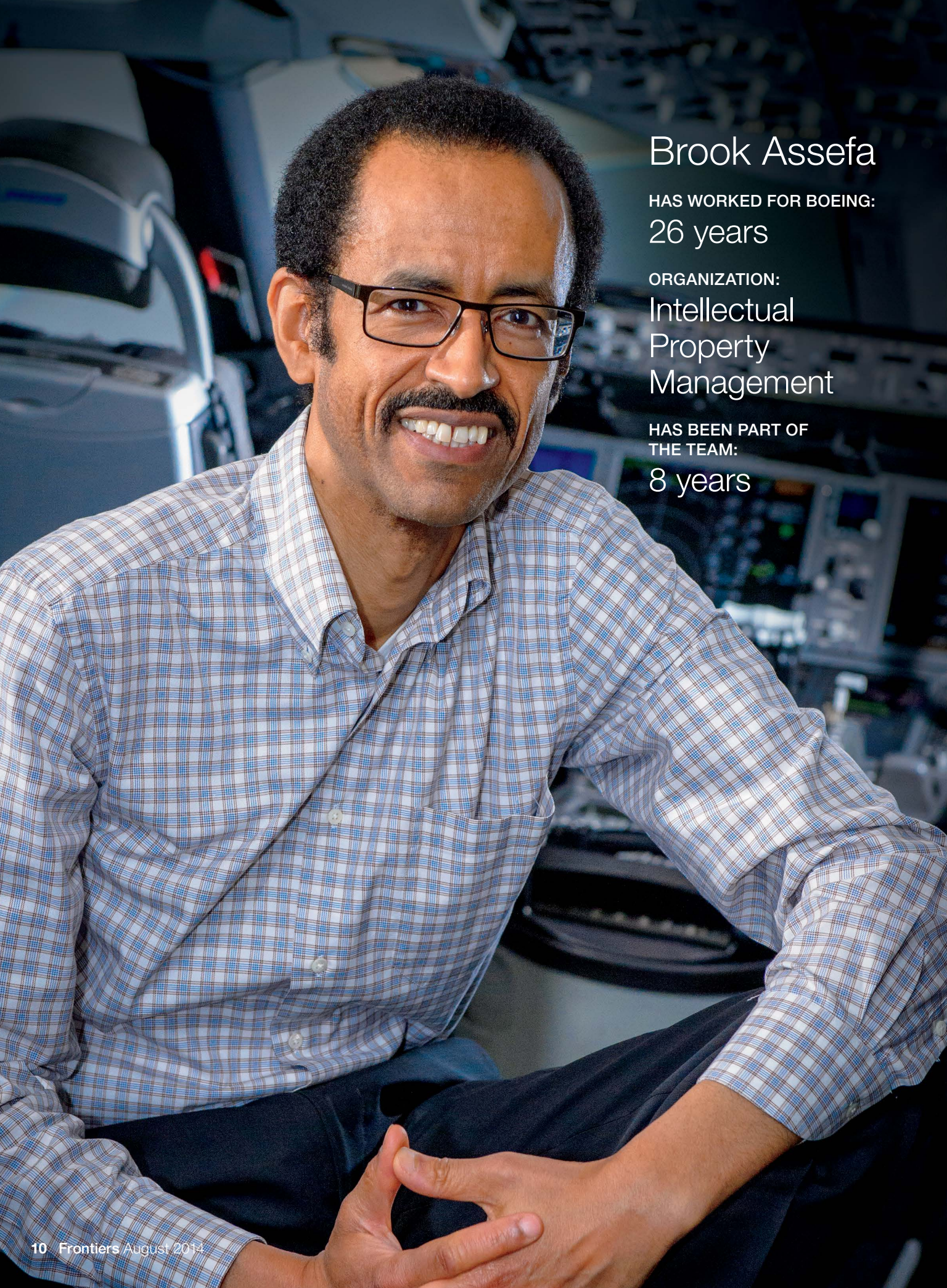
“I am alive and standing here today because of the product you built.”

—U.S. Air Force Gen. Mike Hostage, an F-15 Eagle pilot and commander of Air Combat Command at Langley Air Force Base in Virginia, during a visit to Boeing’s St. Louis site. *Boeing News Now*, June 24

“This is not your mother’s 747.”

—Eric Lindblad, vice president and general manager of the 747 program, talking about the latest 747-8 Intercontinental delivered to Lufthansa Airlines. It was the 1,500th 747 built by employees at the Everett, Wash., plant. *USA Today*, June 27





Brook Assefa

HAS WORKED FOR BOEING:
26 years

ORGANIZATION:
Intellectual
Property
Management

HAS BEEN PART OF
THE TEAM:
8 years

WHAT WE DO

Patent guide

This employee helps turn great ideas into valuable patents

As told to Elizabeth Davis, with photo by Marian Lockhart

Brook Assefa manages patent portfolios in the Intellectual Property Management organization. In this *Frontiers* series that profiles employees discussing their jobs, Assefa explains why his past experience as an engineer gives him a greater appreciation of the need to patent inventions.

My job is full of challenges and surprises. I work on exciting inventions from our best engineers and technologists. On any given day, I might find myself working on satellites, autopilots, maintenance systems or with unmanned aerial vehicle patents.

My role is to go around the company and engage inventors, review their ideas and submissions, and oversee patent application filings to ensure we protect the inventions we develop. I collaborate with our creative employees, and together we solve problems that make a difference.

I know from firsthand experience that Boeing employees generate many valuable inventions that make our products and services even better. That's why it's really important for Boeing employees to patent the inventions they create, and it's why I put a lot of effort into guiding inventors through the invention disclosure process.

While each of us on the Patent Portfolio Management team specializes in a particular technical area such as manufacturing, networks, structures or systems engineering, we work together to assess whether a proposed invention should be considered for patenting. Sometimes

we determine that an invention should be protected as a patent that we disclose; for others, we feel they're better kept as a trade secret.

Regardless of the outcome, we're concerned with ensuring that all Boeing inventions are positioned to generate the highest value for the company.

I've always been interested in airplanes, so joining Boeing was a dream come true for me. I came to the company straight from college with a degree in applied math, which I used as a software analyst. After several years I discovered that an engineering career could be incredibly versatile and got my master's in electrical engineering by taking classes at night.

I spent 14 years in engineering before thinking it was time to try a new career within Boeing. Before I moved from avionics to intellectual property, I realized I needed additional training. I worked full time while I attended graduate and law school. In fact, I excelled in school because of the skills I learned on my day job. And I was fortunate that Boeing's Learning Together Program helped make my educational dreams a reality.

My new degrees prepared me to take on more challenging assignments

and provided different lenses through which I could connect with technology and help advance the business.

In my role in Intellectual Property Management, I know that Boeing's success depends on nurturing the invention disclosure pipeline. Thanks to my experience as an engineer, I can speak the language of engineering. Thanks to my graduate education, I can help shepherd a technologist's ideas through the complex submission and patent process.

The job's a good fit: Engineers always try to understand the functional difference between old and new. I work with our inventors to better articulate that "patentable" difference.

Successfully turning great ideas into valuable patents depends on good planning, attention to detail, and working well with others. The strength of our patent portfolio sets Boeing apart from our competition. I take great pride in my role here—recognizing the innovation that is constantly taking place around the company, and using it to further our future. ■

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Commercial Airplanes
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Jet,





set

Boeing Business Jets pushes boundaries—and innovation—for customers

By Elizabeth Bieri

PHOTO: Boeing Business Jets were the first Boeing airplanes to incorporate enhanced vision systems (seen on the nose), an avionics system that uses infrared to provide pilots increased visibility of the runway environment. **BOB FERGUSON/BOEING**

In a small office tucked away on the Boeing Field flight line in Seattle, a team of Commercial Airplanes employees works every day to satisfy the unique, and sometimes whimsical, requirements of some of Boeing's most secretive and influential customers—Boeing Business Jet owners.

Depending on the owner's specifications, customized jets known as BBJs may be outfitted with everything from luxury bathrooms to glossy conference tables. For jumbo 747s, private elevators are an option. One client turned his airplane interior into a spacious gathering room centered around a golden throne.

"BBJ is a boutique business," said Steve Taylor, president of Boeing Business Jets and a pilot licensed on every current Commercial Airplanes model. He often delivers the airplanes personally. "Every customer is different and has unique needs for their aircraft."

The clientele for these private jets includes some of the world's most influential people, from Fortune 500 CEOs to heads of state. Unlike Boeing's airline customers, who use their fleets to generate revenue, private-jet owners are looking for the ultimate in comfort and convenience, whether they use their airplane for business or pleasure.

In China, many BBJ operators are business owners who require more passenger capability than Western business owners, because they usually travel with larger groups of employees, said Taylor. Heads of state, on the other hand, require the space, flexibility and security to conduct government business while flying.

BBJ's business model reflects these

PHOTOS: (Right) Carlos Horan and Amy Wisch review customer plans on board a BBJ. **BOB FERGUSON/BOEING** (Insets, from left) A family room setup on board a BBJ; a shower in a stateroom. **BOEING**







Birth of the BBJ

Editor's note: In an interview shortly before he retired from Boeing in April 2002, Borge Boeskov, the first president of Boeing Business Jets, recounted the program's birth to James Wallace, then-aerospace writer for the Seattle Post-Intelligencer newspaper. Wallace now is editor of *Frontiers*; Boeskov died in 2004. Here, Wallace recalls their conversation, and the dinner that led to the creation of a new Boeing business line.

It started with a conversation between old friends.

In early 1996, Phil Condit, then-Boeing president, was having dinner with General Electric boss Jack Welch when Welch mentioned he had been considering using one of Boeing's Next-Generation 737-600s as a business jet. But it didn't have enough range, Welch said. The airplane was among those that had been ordered by GE through the company's leasing arm, GE Capital.

A few days later, Condit telephoned Borge Boeskov, vice president of product strategy for Boeing Commercial Airplanes, and told Boeskov about his dinner talk with Welch about business jets, and his concerns about the lack of range of the 737-600. Could Boeing do better, Condit asked.

About a week later, Boeskov had an answer—a business jet that would use the fuselage of the 737-700 and the bigger wing of the 737-800 for

more fuel and thus more range. Welch was enthusiastic about the idea and told Condit their companies should become partners, with GE supplying the engines.

The joint venture was announced on July 2, 1996, in New York City. Condit and Boeskov arrived early that day and had lunch with Welch before the announcement. Welch wanted to know how many business jets Boeing thought it could sell in a year, in case the question came up during the news conference.

Boeskov told Welch that Boeing had internally forecast it could sell six to eight planes a year.

Mentioning a single-digit sales number was "never" a good idea, Welch replied. He suggested they tell the media Boeing expected to sell at least 10 jets a year. And that was the figure announced at the news conference.

To date, customers have ordered 217 Boeing Business Jets—or about 12 a year. ■

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diverse customer requirements.

“We work on a one-on-one basis with every customer over a long period to deliver the product that the customer requires,” Taylor said. “Selling the airplane to the customer is just the beginning of the relationship.”

Since 1996, when BBJ was formed, the program has sold 217 airplanes—176 are in service today. Twin-aisle airplanes have accounted for nearly 40 percent of net orders since Boeing introduced the 747-8 and 787 into its business-jet lineup.

One reason for the program’s success, according to Mike Curtis, BBJ Sales, is the focus on pushing boundaries in order to satisfy customers—resulting in innovations that sometimes find their way onto commercial jetliners.

For example, BBJ was the first program within Boeing to introduce winglets—now offered on its Next-Generation 737s. BBJ also was the first to use lower-cabin-altitude technology—later popularized by the 787 Dreamliner. In addition, BBJ offers customers a much quieter flying experience than most commercial airplanes—typically 52 decibels or less compared with an average of more than 62 decibels on commercial flights.

Although Boeing builds the airplane shells, the custom interiors and exterior paint schemes are designed and installed by others. There are 17 Boeing-approved completion centers around the world, more than half of them outside the United States. Boeing Business Jets delivers the airplanes to customers with an unfinished interior—

PHOTOS: (From far left) A BBJ in flight; BBJs allow for a bigger galley compared with other business jets. **BOEING** A BBJ logo in Seattle. **BOB FERGUSON/BOEING**



“Selling the airplane to the customer is just the beginning of the relationship.”

—Steve Taylor, president of Boeing Business Jets and a pilot licensed on every current Commercial Airplanes model

PHOTO: **BOB FERGUSON/BOEING**

referred to as green configuration—and arranges for the installation of a long-range, auxiliary fuel system.

But that's the beginning of Boeing's involvement. The team of about two dozen BBJ employees helps customers negotiate the full process of becoming a business-jet owner, from conception to installation—a stage that can take up to two years to complete.

"BBJ is a one-stop shop for our customers," said Mark Garvin, a completions manager working for BBJ at Boeing Field. "We guide our customers through everything from the contract to the customized interior completion process to in-service field issues. This level of personalized service allows our customers to feel like their specific needs are being catered to and taken seriously."

Garvin said the team approaches each day with an open mind to meet customer requests that can range from standard charter-like operations to full-size living spaces, including theaters and staterooms. While the completion center works up the design concept, the Boeing business-jet team handles practical considerations.

"Commercial aircraft are not designed with customized interiors in mind—they are designed for airlines," said Anders Brown, airplane configuration and integration engineer with BBJ. "It is our job at BBJ to make

sure that these highly customized features are safe to install in our aircraft."

The team has had many engineering challenges over the years, from installing an interior wall made of plants to adding a customized window that is more than three times the width and more than 40 percent taller than a normal airplane window.

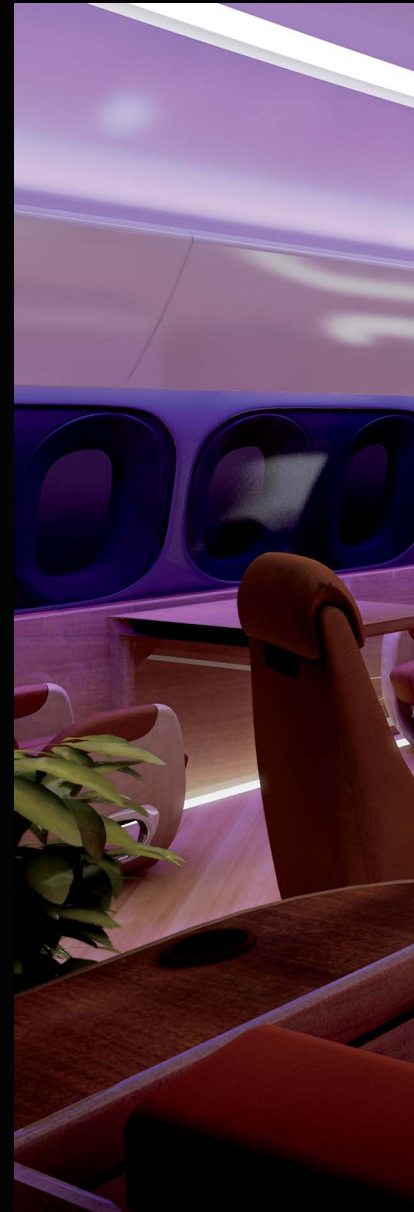
"The challenges that we work through at BBJ are very different from the rest of Commercial Airplanes and really require a different mindset," Garvin said. "But it is incredibly rewarding to be involved with customers every step of the way and develop one-of-a-kind products." ■

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Karen Crabtree contributed to this story.

PHOTO: (Bottom middle) The master suite on board Chinese charter company Nanshan Jet's newest BBJ. **BIZJET**

GRAPHICS: (Clockwise from right) An artist's concept depicts a theater room on board a BBJ 787; a BBJ 747-8 provides enough room for a second floor. **TEAGUE** A large master bath shower and sink as a concept for a BBJ 787. **ANDREW WINCH DESIGNS AND LUFTHANSA TECHNIK**





Above the crowd

Take advantage of opportunities
to stand out and get ahead

By JoAnn Houlihan and Ron Taylor



Monica Menzione learned a valuable lesson from her mother the day she graduated from high school. She wanted to take a year off before entering a university to study languages, but her mother said if she did that she would have to help with chores and cleaning.

“So I went to university right away and have never stopped studying,” Menzione recalled.

An international business support lead based in Rome, Menzione continues to be drawn to opportunities at Boeing that allow her to learn, stretch her abilities, and grow as a person and as an employee.

During her 13-year career with Boeing, Menzione has tapped into a number of development resources, including Learning Together—the company’s tuition assistance program—and short-term assignments in other countries to hone her skills and learn new ones.

Taking the initiative on skill building and self-development makes employees such as Menzione stand out from others, according to Antonio De Palmas, Italy country president.

“We can provide options, but you have to be accountable for your career,” he explained. “Your performance is the base line. If you are accountable for it and plan your career, you are setting

the expectation for a two-way dialogue about development.”

Tony Parasida, senior vice president of Human Resources and Administration takes it a step further. “Employees who are at the ready with a specific skill set have an advantage over others who do not,” he said. “Boeing offers a number of development resources—those who take advantage can benefit both personally and professionally.”

Menzione is certainly an employee who has taken that to heart.

In addition to her passion for learning new languages—she has mastered six—she has pursued several degrees and certifications with help



Outstanding tips

The three employees interviewed for this story share their tips about how to get ahead and stand out at Boeing.

- Apply yourself in every situation.
- Pay attention to detail.
- Follow through and meet deadlines.
- Build your skill set—become a better-rounded employee.
- Let your manager know what your goals are.
- Look for opportunities.
- Be organized.
- Deliver on commitments.

from the Learning Together Program.

She also has embraced development opportunities in other Boeing locations, including a three-year stint in the Netherlands office helping build the payment center for Boeing International. And she spent two weeks providing short-term business support to the Brussels office and will be on assignment in Seattle starting in September as part of a global rotation program.

“It’s not easy to find companies that give you these kinds of development opportunities,” Menzione said. “I strive for excellence and come into every situation with an open mind.”

Ruth Marciniec also has taken

on new challenges to get ahead in her Boeing career. She is part of the business finance operations team for the B-1 bomber program in Oklahoma City. Her team is working on contracts for modifications to extend the iconic bomber’s life span for years to come.

“I like challenges and trying new things,” said Marciniec, who has been with Boeing for three years. “It’s important to seek out new opportunities—not wait for them to come to you. And take on challenges that move you out of your comfort zone.”

Last year, she took on a developmental assignment with Financial Operations supporting the

Full Scale Fatigue Test and Execution project on the bomber. The teams are located across the country, which requires good communication and mutual agreement on expected deliverables, she said.

“From day one I worked with the teams to create an environment of open communication. We are just now completing the first phase of the project and I think everyone feels comfortable

PHOTOS: (Far left) Monica Menzione’s passion for learning has led to numerous job rotation opportunities in three countries. **ASSOCIATED PRESS** (Above) Being organized is one key to Aaron Ramey’s success. **GAIL HANUSA/BOEING**

Resources for success

Boeing offers several resources for employees who want to stand out from their peers.

- Mentoring programs—formal or informal
- Performance Management—set tough Business Goals & Objectives (BG&Os)
- Your manager—can help you create a development plan
- Job rotations—for more information search for “Rotation and Development Programs” on MyBoeing
- Pursue an individual course, certificate program or degree—visit the Learning Together Program on TotalAccess



“You have to be accountable for your career.”

—Monica Menzione, International Business Support lead, Shared Services Group, Rome

making suggestions or raising issues and concerns they may have. And that has made all the difference.”

Keeping an eye out for the next challenge also has worked well for Aaron Ramey during his 18 years at Boeing. He started as a line mechanic, worked his way up to team lead, then manager, and now is a temporary senior manager in 747 forward fuselage in Everett, Wash.

“I’ve always worked to be the best I can be in my job while learning my manager’s job, and teaching others my job,” Ramey said. “That way I’ve been ready to take on new challenges, and not worry I would be leaving a hole behind. And so far that philosophy has worked out

pretty nicely for me and others as well.”

Parasida said employees such as Ramey, Menzione and Marciniac who take on new opportunities to grow are “gaining valuable experience, acquiring business insight, and building their networks. As a result they stand out, and have earned greater access to plum assignments and career advancement opportunities.” ■

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PHOTO: Ruth Marciniac says it’s important to seek out new opportunities. **ASSOCIATED PRESS**

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Road map to retirement

Boeing provides resources for employees at every stage in their careers

By Carrie Howard

When Adam Hoefer joined Boeing as a structural and payload design engineer two years ago, he was just starting to pay off his college loans.

But even though retirement was a long way off, Hoefer already had a plan. From his first day on the job in Huntsville, Ala., Hoefer began contributing to Boeing's Voluntary Investment Plan, or VIP, even though he had his student loan financial obligations.

"I've had a plan for retirement since starting my career, and I've always known that I needed to start saving

as soon as I could," said Hoefer, who works at the Boeing site in Advanced Design and Prototype Solutions, part of the Phantom Works organization with Defense, Space & Security.

"Once you set the money aside, you don't miss it," he added.

Regardless of where employees are in their careers, Boeing provides a range of resources to help them achieve their long-term financial goals, according to Tony Parasida, senior vice president, Human Resources and Administration.

But some employees are not taking

"Once you set the money aside you don't miss it."

—Adam Hoefer, structural and payload design engineer, Phantom Works

PHOTO: ERIC SHINDELBOWER/BOEING



“It’s an investment in my future, and to me that’s an important priority.”

—Heather Robertson, performance consultant,
Learning, Training and Development

PHOTO: JESSICA OYANAGI/BOEING

full advantage of those resources, including the Voluntary Investment Plan, he said, explaining that Boeing employees left \$98 million in potential company matching contributions to their retirement savings on the table last year.

About half of Boeing’s employees are age 50 or older, and they will be eligible for retirement in the next five to 10 years. The average VIP account balance for that group is approximately \$280,000, which experts say may not be enough for a financially secure retirement. Employees in this group are eligible to make pretax catch-up contributions in addition to regular pretax contributions (up to the IRS limit of \$5,500 for 2014) to help them meet their retirement goals.

“We want employees to understand that it’s never too early to get started on retirement planning, but it’s also never too late,” Parasida said.

The Voluntary Investment Plan allows most employees to enroll as soon as they are hired and save for retirement by contributing on a pretax or after-tax basis. In addition, nonunion employees and certain union-represented employees are now eligible to contribute up to 100 percent of their incentive pay on a pretax basis. The company also may contribute to the plan in matching contributions or automatic company contributions.*

Most employees need to contribute at least 8 percent of their base pay each pay period to receive the maximum matching contribution.

Company matching contributions are made each pay period and are fully vested immediately.

To help employees make investment choices related to their Voluntary Investment Plan, Boeing offers on-demand financial planning and retirement overview seminars through the Boeing Education Network investment adviser services, and other tools through Boeing Savings Plans Online.**

As a fairly recent hire, Hoefer has attended several of the on-demand financial planning seminars offered by Boeing. “Based on what I learned I’ve diversified more,” he said, “but I’m still fairly aggressive in my investing since I’m so far from retirement.”

Another employee, Heather Robertson, joined Boeing four years ago, as a performance consultant with Learning, Training and Development in the Puget Sound area in Washington state. Robertson, who worked for several other companies before joining Boeing, participated in her previous employers’ retirement plans, so it was natural for her to sign up for Boeing’s Voluntary Investment Plan.

As a recent hire, she was able to speak with a representative of Ayco about her financial goals. Ayco offers Boeing retirement planning seminars in person and through Boeing Education Network, as well as tools for reaching other financial goals, such as saving for college or buying a house.***

“I was happy to learn that I am on track to achieve my goals,” she said. “Next, I’m interested in having them look at my investment allocations to give me feedback on diversification. I feel like it’s an investment in my future, and to me that’s an important priority.”

While Robertson and Hoefer are early in their Boeing careers, Mark Leppert is a lot closer to the end of his. A 25-year Boeing veteran, Leppert is with Boeing Test & Evaluation in Seattle. He has been a longtime participant in the Voluntary Investment Plan. He, too, recently attended an on-



“You need to actively plan for your retirement ... The earlier you start, the better off you will be.”

—Mark Leppert, business and planning analyst, Boeing Test & Evaluation

PHOTO: JESSICA OYANAGI/BOEING

demand class on retirement planning.

“I’ll probably retire in five to seven years,” Leppert said. “The class was a reminder that you need to be sure your ducks are in order so you can retire when you want to, not when you can afford to, because you’ve planned in advance at the beginning of your career.

Looking back over his career, Leppert said he knows firsthand the value of planning early for retirement, just as Hoefer and Robinson are doing now. “You need to actively plan for your retirement,” he said. “You can’t just say, ‘Well, I’m not going to retire for another 20 years,’ and put it off. The earlier you start, the better off you will be.” ■

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**Employees should go to the Contribution section of their VIP account at Boeing Savings Plans Online to confirm if Boeing matches their contributions and at what level or provided an automatic company contribution. Union-represented employees of unions that have not yet negotiated the 30 percent maximum contribution may contribute up to the maximum percentage allowed under the applicable bargaining contract.*

***Eligible participants for ING Advisor Service include nonunion employees and employees represented by a union that has negotiated for participation in the ING Advisor Service.*

****Neither the Employee Benefit Plans Committee nor The Boeing Company endorse the independent advisory services provided by ING Advisor Service, or the education and planning services provided by Ayco, and are not responsible for the advice employees receive from these service providers. Employees should consult with their own professional advisers (tax, investment, legal or otherwise) regarding their individual circumstances and objective.*

HIGH PERFORMER

Phantom Eye demonstrator
soars over the desert

By James Wallace and photos by Bob Ferguson



Long before daybreak in the high desert of California, a Boeing team prepares the Phantom Eye demonstrator for another in a series of test flights. It will be a few hours before this one-of-a-kind unmanned aircraft—powered by two Ford Ranger engines converted to burn hydrogen—lifts off from its special launch cart and soars away over the Mojave Desert.

On this June test flight, shown in the photos on these pages, the Phantom Eye demonstrator reached 43,400 feet (13,300 meters).

The goal is for the demonstrator to cruise up to 60,000 feet (18,300 meters).

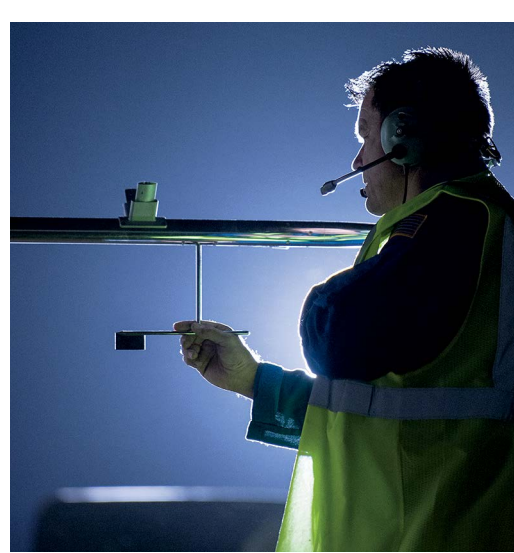
With prototype development funded by Boeing Phantom Works, the Phantom Eye demonstrator is designed to cruise

high above the earth for days at a time, providing new capabilities for intelligence, reconnaissance and surveillance, and a variety of other military or civilian missions. Since June 2013, Boeing has been on contract to fly instrumentation payloads aboard Phantom Eye for the Missile Defense Agency.

Phantom Eye flew for the first time more than two years ago, the start of a comprehensive flight-test program that has seen higher and longer missions as

PHOTO: Before sunrise, Boeing's Phantom Eye demonstrator is towed from its fueling pad for preflight preparations. Its unique liquid hydrogen fuel system requires safety procedures more like a spacecraft's than an airplane's.





its flight envelope has been carefully expanded. All test flights have taken place from the dry lakebed at NASA's Armstrong Research Center at Edwards Air Force Base.

To minimize the prototype's weight and improve its altitude and endurance capabilities, Phantom Eye has distinctive takeoff and landing gear. It rests on a special launch cart

as it speeds down the lakebed, and when the wings generate enough lift, Phantom Eye separates from the cart, which brakes to a stop. For landing, Phantom Eye approaches the lakebed at about 70 mph (110 kilometers per hour) and lands on a lightweight main landing gear skid like a glider. Its nose gear features a caster for landing.

But what sets Phantom Eye apart

PHOTOS: (Opposite page, clockwise from top) Dan Watts, Boeing Research & Technology engineer, prepares to disconnect the demonstrator from the tow vehicle; Program Manager Brad Shaw monitors weather conditions; the Launch and Recovery team completes a safety huddle. (This page, top photos) Jon Muir, flight-test operations manufacturing manager, Boeing Test & Evaluation, performs checks on air data sensor vanes. (Above) The demonstrator's engines come alive.

from other unmanned aircraft is its liquid hydrogen–fueled propulsion system. Liquid hydrogen has three times more energy than aviation fuel and burns more cleanly. The Phantom Eye engines leave only water vapor in the atmosphere.

With a 150-foot (46-meter) wingspan, the Phantom Eye demonstrator can carry a 450-pound (200-kilogram) payload. A full-size version is expected to carry a 2,000-pound (900-kilogram) payload or stay aloft for up to 10 days. ■

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For more about Phantom Eye see the April 2013 and July 2012 stories in Frontiers.

PHOTOS: (Below) Once Boeing has proved the Phantom Eye demonstrator’s capabilities for high-altitude, long-endurance missions, a full-size variant of this unmanned aircraft system can be built for customers. Mission payloads could include intelligence, surveillance and reconnaissance sensors, Earth-mapping technology and other communications equipment that can play a crucial role in remote areas of the world or following natural disasters. (Opposite page, from top) Phantom Eye takes off from a special cart—the innovative design saves a considerable amount of weight, allowing the demonstrator to carry more fuel and payload; once airborne, Phantom Eye flew for more than five hours on this test flight and reached an altitude of 43,400 feet (13,300 meters).





Rooms for im

Immersive Development technologies yield quick solutions across Boeing

By Eric Carlson and photos by Bob Ferguson

As a former soldier, Boeing's John Chicoli knows how important it is to keep the company's military programs on schedule—so they can deliver critical equipment and capabilities to warfighters.

Chicoli is program manager for Phantom Badger, a vehicle designed to carry warfighters and their equipment across challenging terrain, and which can be quickly transported inside the V-22 tilt-rotor and other aircraft. So when Phantom Badger was going through an accelerated modification program and Boeing's partner needed a proposed part made to check its fit, Chicoli knew he needed to get it there quickly.

Only 16 hours after the design for the part was sent to Boeing, a newly "printed" part arrived at Boeing partner MSI Defense Solutions in North Carolina, ensuring the program continued to remain on schedule.

The part was printed in St. Louis using additive manufacturing, or 3-D printing, by the Immersive Development (ImDev) team in Phantom Works.

"When you're building these parts,"

explained Chicoli, "you have to have them right the first time, or it slows you down and costs more money. Tools like Immersive Development allow us to get it right."

Additive manufacturing is just one of the many technologies and capabilities the Immersive Development team is deploying across Boeing programs.

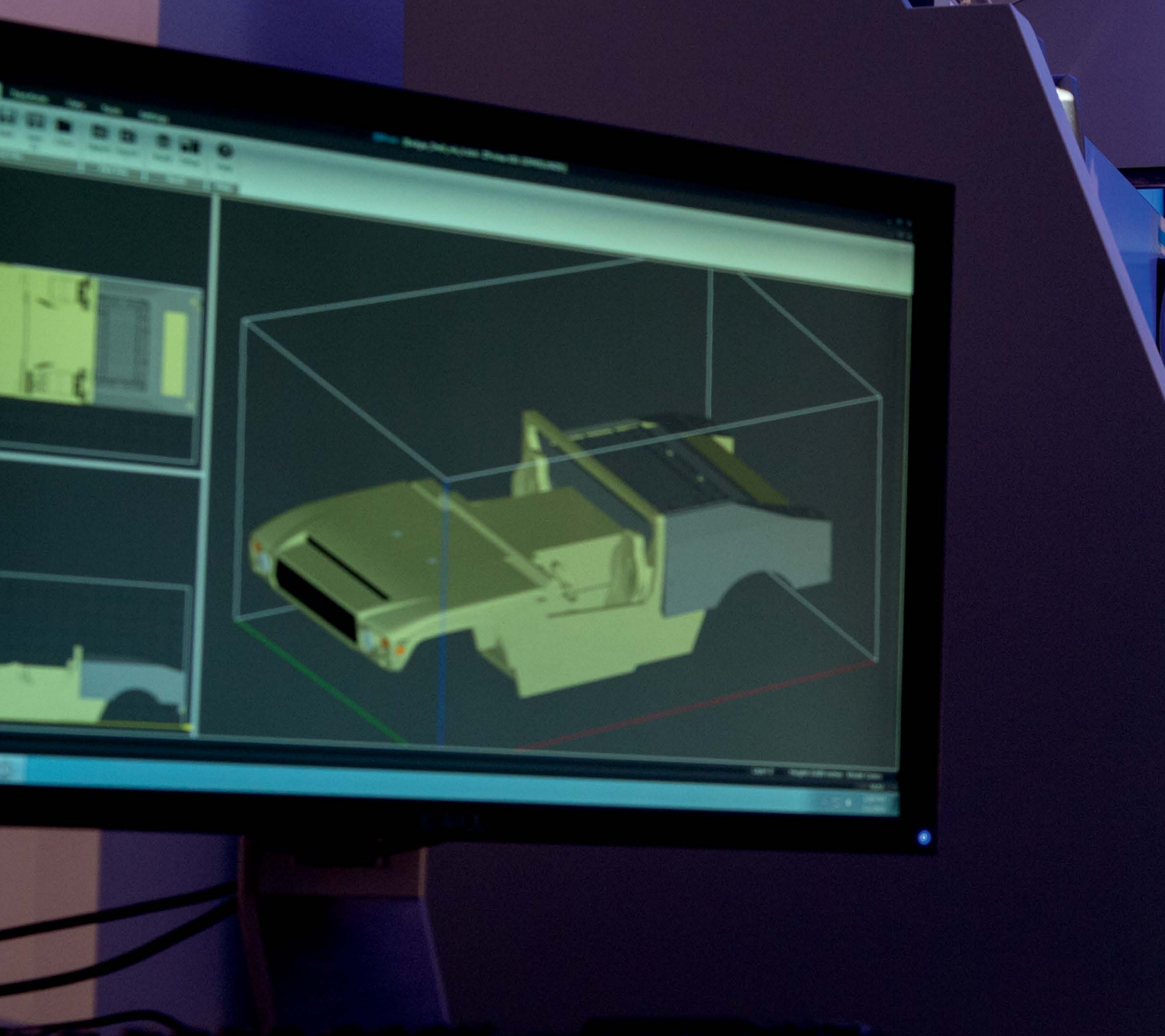
"We currently have 16 capabilities in our portfolio," said Dan Seal, Immersive Development program manager. "Some of the key capabilities are actual immersive collaboration rooms that bring people together physically. We've deployed 45 of those to programs to date."

Each of these rooms is tailored for the specific program, the specific team and where each program is in its life cycle. The rooms range from very small ones that hold four to six people, to

PHOTO: (Foreground) Bailey Schevers, left, and Derek Joseph analyze a model in the Mission Systems lab, as team members collaborate in the background.

provement

A photograph of a group of people in a laboratory or office setting. In the foreground, a woman with blonde hair tied back, wearing a beige cardigan over a patterned top, and a man in a white button-down shirt are looking towards the left. In the background, another man in a purple shirt and a woman are also looking in the same direction. The scene is lit with blue and purple ambient light. A large yellow number '3' is visible on the wall in the background. The word 'provement' is written in large, bold, yellow lowercase letters across the top of the image.



some that can hold almost 100 people.

“It really speeds up innovation because physical collaboration enables innovation,” Seal explained. “The faster and the better you can collaborate, the better you can innovate.”

Another important capability, given Boeing’s global presence, is virtual collaboration in computer-simulated environments. Users can communicate, share data, and collaborate with one another in real time, regardless of where they’re located. It’s not a substitute for the innovation and collaboration fostered by working alongside colleagues, but it’s another ImDev tool that is bringing together Boeing employees, tools

and processes to achieve a common objective, Seal explained.

The approach of bringing these elements together is exemplified by another ImDev capability, Teamcenter Visualization Mockup.

“This tool allows us to load thousands of models at once so we can visualize entire sections of an aircraft,” said Ryan Dognaux, a visualization engineer on the ImDev team. “It’s an important capability because it allows multiple integrated product teams to review the aircraft sections with all the subsystem geometry appearing—structures, wiring, hydraulics—and we can

go through them as a team before anything is touched in the real world.”

The teams are able to look at the cross sections and, layer by layer, make sure everything is aligned and working properly. Not unlike an X-ray, this noninvasive approach to diagnosing potential design faults eliminates the need for expensive, time-consuming remanufacturing or modifications further into the development cycle, Dognaux said.

The many ImDev capabilities are being applied to different programs across the Boeing enterprise. Travis Durand, director of Engineering for Boeing Military Aircraft, utilized some



of those capabilities when he was chief engineer on the F-15 program.

“At the time, we had heard about the Immersive Development activities and we were looking to start a new project to redesign a significant portion of the F-15 structure, and wanted to use the ImDev tools to do that work,” Durand said.

“This was a complete redesign from the ground, up,” he said. “Every single part was redesigned, put into 3-D models, and integrated with the use of these tools... The result was a lot of savings not only in terms of shop hours coming off the assembly time but also in terms of the whole back office, including the supply chain. We spent

fewer hours and had better-quality products all the way with the use of this environment and these tools.”

By bringing together all stakeholders at the beginning of the design cycle, teams are able to quickly design, test and modify new products much more affordably—an imperative in today’s budget-constrained environment.

“ImDev shortens product development cycle time and therefore shortens the cost of product development, and we do that by pulling together all the stakeholders early,” Seal said. “It allows you to focus on getting the design right upfront. The team can come together and make informed design decisions

with all the stakeholders very, very quickly. When you do that, you get first-time quality, reduced cycle time and reduced cost. It’s an important step in our efforts to break the development cost curve.” ■

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For more about 3-D printing, see a related video at boeing.com/frontiers/videos/august14

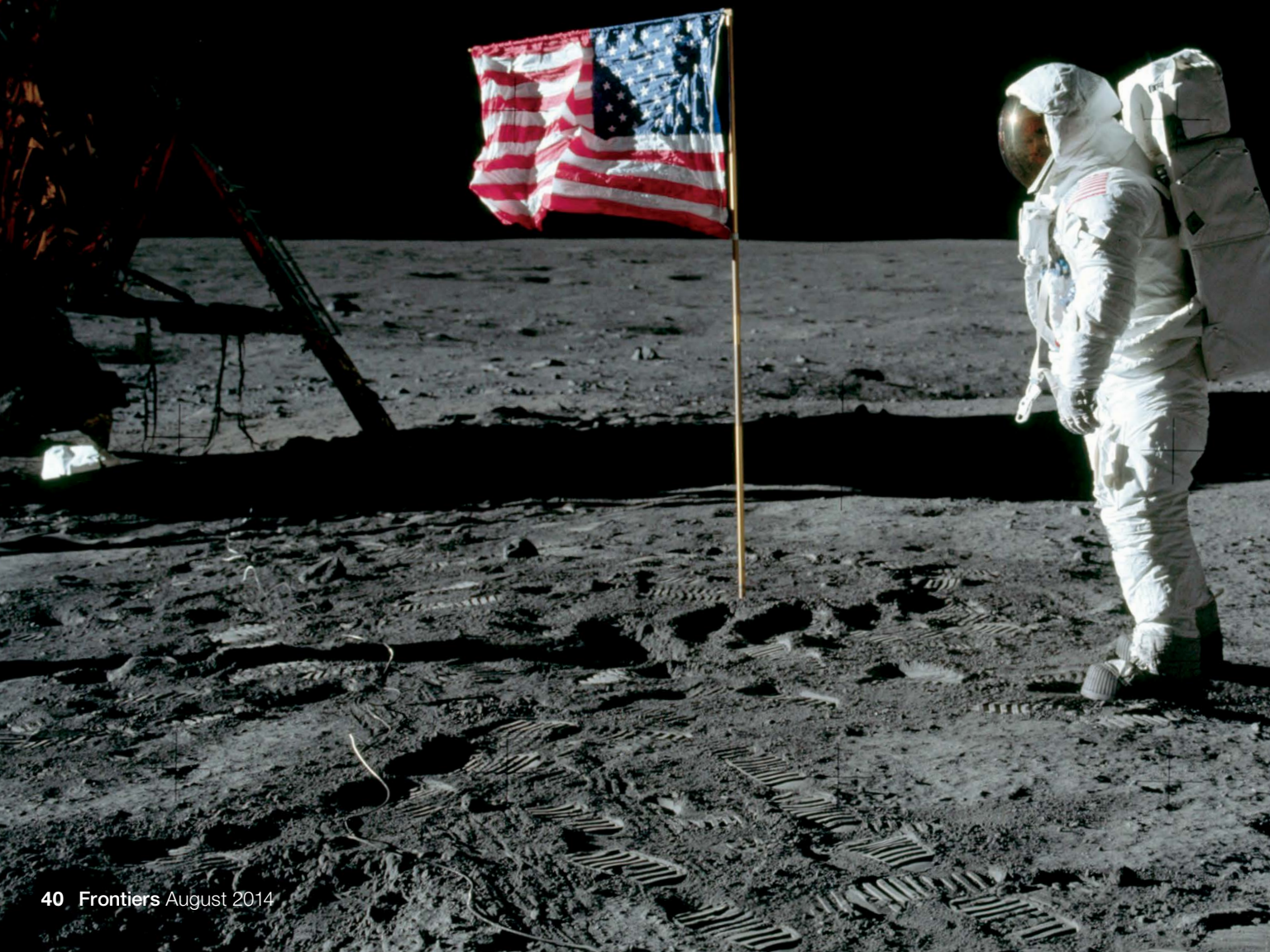
PHOTO: Brandon Cabot, left, and Ryan Dognaux, engineers in the Immersive Development group, examine a freshly printed Phantom Badger model.

HISTORICAL PERSPECTIVE

‘Live’ via satellite

Intelsat and Boeing have connected
the world from space for 50 years

By Paula Shawa





On July 20, 1969, as Apollo 11 astronaut Neil Armstrong became the first human to walk on the moon, people on Earth were able to watch the historic feat live on television.

From more than 238,000 miles (383,000 kilometers) away, Armstrong famously declared his first step on the lunar surface represented a “giant leap” for mankind. But the advances that enabled people to witness the moon walk as it occurred also represented a giant leap in communications satellite technology. The lunar landing marked the first event transmitted live to a global audience, reaching more than 500 million people on six continents.

The organization that helped make it happen, the International Telecommunications Satellite Consortium, or Intelsat, may not be readily familiar. But over the years, Intelsat has made it possible to witness firsthand, in real time, history-making events, from Apollo 11 to the Olympics to World Cup soccer. The formation of Intelsat 50 years ago, on Aug. 20, 1964, paved the way for “live via satellite” becoming a reality.

And Boeing-built satellites and launch vehicles have been part of that story.

The United States and 17 other countries signed the agreement creating Intelsat, whose mission

was to launch a fleet of satellites into space to build the first global communications network. Intelsat contracted with NASA to launch the satellites, and private industry to build them—and the connection to Boeing and two of its legacy companies began.

The Space and Communications group of Hughes Aircraft built many of the early Intelsat satellites at its facility in El Segundo, Calif. Hughes Space and Communications was acquired by Boeing in 2000 and continues to partner with Intelsat today as Boeing Space & Intelligence Systems. Its Satellite Development Center is in El Segundo.

Douglas Aircraft, another Boeing heritage company, built the Delta rockets that launched all the early spacecraft; today the Delta heritage continues through the United Launch Alliance, a joint venture of Boeing and Lockheed.

The first Intelsat satellite to be carried aloft was Intelsat I, or Early Bird, on April 6, 1965. Built in the

PHOTOS: (From far left) Edwin E. Aldrin Jr. poses for a photo by Neil Armstrong during the lunar landing, the first event transmitted live to a global audience.

NASA A crowd gathers around an airport television set in Sydney, Australia, to watch the broadcast of astronauts Aldrin and Armstrong on the moon in July 1969.

TREVOR DALLEN/FAIRFAX SYNDICATION



Hughes facility, Early Bird was the first commercial communications satellite to be placed in geosynchronous orbit.

Intelsat I weighed only 76 pounds (35 kilograms) and was less than 3 feet (1 meter) high. Nevertheless, it achieved several firsts in connecting Earth from space, providing the first direct contact between Europe and North America via television, telephone, telegraph and fax.

With the next two generations of spacecraft, Intelsat II and III, Intelsat was on its way to fulfilling its mission. Intelsat II was a series of four satellites also built by Hughes. A different aerospace firm, TRW, built the Intelsat III spacecraft.

The full network went into service just in time for Apollo 11. When Neil Armstrong emerged from the lunar lander, one of his first actions was to deploy a TV camera for the live feed. The signals followed a circuitous path, traveling first to a ground station in southern Australia and then to one in

eastern Australia, which forwarded them to an Intelsat III satellite above the Pacific Ocean. From here the signals could be shared with other Intelsat satellites and broadcast live by television.

Apollo 11 was followed by other "live via satellite" broadcasts that helped connect the world, including every Olympics since 1968 and every World Cup since 1970. Intelsat also provided the hotline connecting the White House and the Kremlin during the Cold War. Intelsat has continued to advance communications satellite capability, providing an early demonstration of the Internet as well as delivering the first international, digital high-definition (HD) transmission between the United States and Japan.

Intelsat membership continued to grow, reaching 200 countries and territories by 2001. The same year, the organization achieved another milestone when it was privatized.

Today, Intelsat is the world's

leading provider of global satellite services, operating a network of about 50 satellites.

And the partnership with Boeing continues.

Space & Intelligence Systems is building a new series called the Intelsat Epic^{NG} (for Next Generation) satellites, which will continue connecting the world from space. ■

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PHOTOS: (Top left) The Intelsat II satellites, built by Hughes Space and Communications, were launched on Delta rockets built by Douglas Aircraft starting in 1966. Both companies are now part of Boeing. **BOEING ARCHIVES** (Bottom left) In May 1992, mission specialists help launch Intelsat VI from Space Shuttle *Endeavour*'s cargo bay. **NASA**

GRAPHIC: (Top right) Boeing continues to partner with Intelsat and is building a new series of satellites called the Intelsat Epic^{NG} (Next Generation). **BOEING**

MILESTONES





IN FOCUS

Timely interception

A three-stage interceptor lifts off from Vandenberg Air Force Base in California June 22 on its way to destroy a long-range ballistic missile target in another test of Boeing's Ground-based Midcourse Defense system. The target missile was fired from a site in the Marshall Islands. After flying into space, the interceptor released an enhanced version of the Exoatmospheric Kill Vehicle, which acquired the target, identified the target's warhead, then intercepted and destroyed it through sheer force of collision. The interceptors carry no armed warhead but use kinetic energy for target destruction.

PHOTO: PAUL PINNER/BOEING





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