

Frontiers

Technology at work

Advanced manufacturing tools and processes are improving safety, production and quality





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Cover: Lorien Le and Larry Fudge inspect fastener installation work of the wing panel assembly line tool in Renton, Wash. In back, from left: Pete Pittman, Kurt Bayer and Sam Dobbs. **BOB FERGUSON | BOEING**

Photo: (Far right) Ron Masset, structure mechanic, sets up the Flex Track automated drilling machine on top of a 777 fuselage section in Everett, Wash. **BOB FERGUSON | BOEING**



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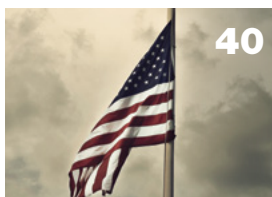
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LEADERSHIP MESSAGE

Michael C. Ford

Vice president

Global Diversity and Inclusion



Make our differences count

Diversity and inclusion are critical to Boeing's success—and future

In this Q&A with *Frontiers*, Michael Ford discusses the importance of diversity and inclusion, and what employees can do to enhance both.

What does diversity and inclusion mean to you?

Think of diversity as counting our differences and inclusion as making our differences count. Both require a welcoming, respectful and engaging environment, where every employee has opportunities for personal and professional development. Employees who work in an environment that allows them to grow and develop are more driven to achieve their full potential.

Diversity and inclusion also serve an important business

purpose, helping Boeing become a truly global company. If we are to remain globally competitive in our second century we must respect different cultures and adapt to the differences in how business is done elsewhere, when appropriate.

You're making a lot of changes in your organization. What's changing and why?

We changed the name of our function to Global Diversity and Inclusion to reflect the worldwide nature of Boeing's business and emphasize the importance of diversity and inclusion to the company's success around the world. We will add diversity managers in several global regions where we expect significant business growth. They will assess the state

of diversity in their region and work with local leadership to develop strategies to enhance diversity and inclusion.

We also are evolving our affinity groups into Business Resource Groups. These groups already do a lot to help our employees professionally and personally. We're enhancing their focus to include the business results that the Resource Groups help drive.

What's the strategy behind the changes?

Research by McKinsey & Co. found that companies in the top quartile for racial, ethnic or gender diversity are significantly more likely to have financial returns above their national industry norms. Diverse



Strategic Focus on:

- Culture
- Talent
- Marketplace



workforces are better at innovating and solving problems; they have higher sales revenues, more customers, larger market shares and greater relative profits than less-diverse companies.

To ensure that Boeing becomes and remains one of those diverse companies, we are adopting a strategy based on three key pillars: culture, talent and marketplace.

The culture pillar is based on the idea that we all want to belong, to be seen, heard, valued and respected. Among other things, we are working to develop an enterprisewide executive diversity council to help establish the strategy, determine the metrics for success, and build on our leaders' significant support for diversity and inclusion. We also are working with Learning, Training and Development to roll out additional diversity-related training for hiring managers, to ensure all candidates and employees receive

a fair opportunity to compete for jobs and to secure development and advancement opportunities.

Our talent pillar rests on the premise that Boeing will be inclusive and engaged with its employees. Our efforts in this area include leveraging succession plans and enhancing selection rates for all, including minorities and women, to identify the next generation of global leaders. We also are working to develop an enterprisewide strategy on diversity recruiting.

Finally, our marketplace pillar encourages employees to think globally and act locally in order to improve the company's standing in its markets throughout the world. We intend to do that, for instance, by strengthening our partnerships with Supplier Management to leverage the impact of our global suppliers, and with Global Corporate Citizenship to build the next generation of talent by investing in communities where we live and work.

How can our employees enhance diversity and inclusion at Boeing?

Sit with people who don't look like you. Have lunch with people you don't know. Learn about another culture—our Business Resource Groups are a great place to start, and every group is open to all employees. Move out of your comfort zone to make room for growth. What I believe you will find is that we are more similar than dissimilar.

When our employees do those things they broaden their own perspectives, and that improves them personally, strengthens their teams, and reinforces the foundation of success for all of us at Boeing. ■

PHOTO: BOB FERGUSON | BOEING

SNAPSHOT

Turkish delight

Two Turkish Airlines 777-300ERs (Extended Range) are prepared for delivery in late March at the Delivery Center in Everett, Wash. They later were deployed on routes from Turkey to North America, including to the airline's newest destination, San Francisco. The Istanbul-based

carrier, which serves more than 250 cities in over 100 countries, has had a long relationship with Boeing. In addition to 777s, it operates a large fleet of Next-Generation 737s and has ordered 65 of the 737 MAX now in development.

PHOTO: GAIL HANUSA | BOEING





QUOTABLES

“We look forward to the first flight of the airplane and can’t wait to get it into our fleet.”

—Ron Baur, vice president, Fleet, United Airlines, which ordered the 737 MAX after spending a year evaluating it against the competition.
Boeing News Now, April 7

“Technology meets history in an exciting way.”

—James Delgado, director of Maritime Heritage with the National Oceanic and Atmospheric Administration’s Office of National Marine Sanctuaries, talking about Echo Ranger, Boeing’s autonomous submersible, after it surveyed a former World War II aircraft carrier resting some 2,600 feet (800 meters) below the surface. Echo Ranger is designed to carry various payloads for underwater intelligence, reconnaissance and surveillance missions. *Boeing News Now*, April 17

WHAT WE DO

Ready to roll!

Moving a big new jetliner out of the factory requires safety, timing and teamwork

BY PATRICK BRISLAWN, AS TOLD TO DAN RALEY

Patrick Brislawn is a toolmaker with the 777 team in Everett, Wash. In this *Frontiers* series that profiles employees talking about what they do at Boeing, he describes the teamwork involved in rolling a newly built commercial jetliner out of the factory—and into the hands of the customer.

I've always been an aviation buff. Growing up, I built model airplanes. I loved to read books and watch TV shows about fast airplanes.

To be a part of it now and have a hand in creating these planes, it's a sense of pride and wonder for me. It reminds you of when you were a kid and things were awesome.

There are two parts to my job: I'm a toolmaker and I'm in production assist—I help move the 777 out of the factory. We do the line move twice a week, 100 times a year. We have a team of 15 and I'm the team lead, and we work second shift, from 2:30 p.m. to 11 p.m. It's less disruptive to roll out a plane at night.

It doesn't do you any good to build an airplane unless you can roll it out to your customer. That's when the delivery process for our customer begins. You have to get them out the door, painted and down the road.

We still have tools we have to make, repair and maintain so they can perform the actual build of the airplane, and that's more satisfying. But, honestly, production assist might be more fun. We get to interact with a lot of great people. We get to move around big equipment. We get to be part of final assembly.

What's involved? We move a lot of portable work stands, and we connect and disconnect utilities. We have to make sure all parts are stored. It's really a simple idea, but it's really hard to do it when you consider all of the parts that make up an airplane. We have to make sure the floor is clear.

We deal with crane operators, forklift operators, production mechanics, functional test technicians, parts people, paint and seal support, maintenance, engineers, planners, coordinators and the folks in the tugs. We're responsible for the process, and rely on all of the different organizations and functions. It seems that Tooling is the organization that has to understand everything and deal with everyone. We're at the epicenter of this process.

Everyone is briefed on the set of tasks, so everyone knows what his or her task is, because it's carefully choreographed. But it has to be done safely. You don't hurry things. You don't take shortcuts. There's a constant focus on safety.

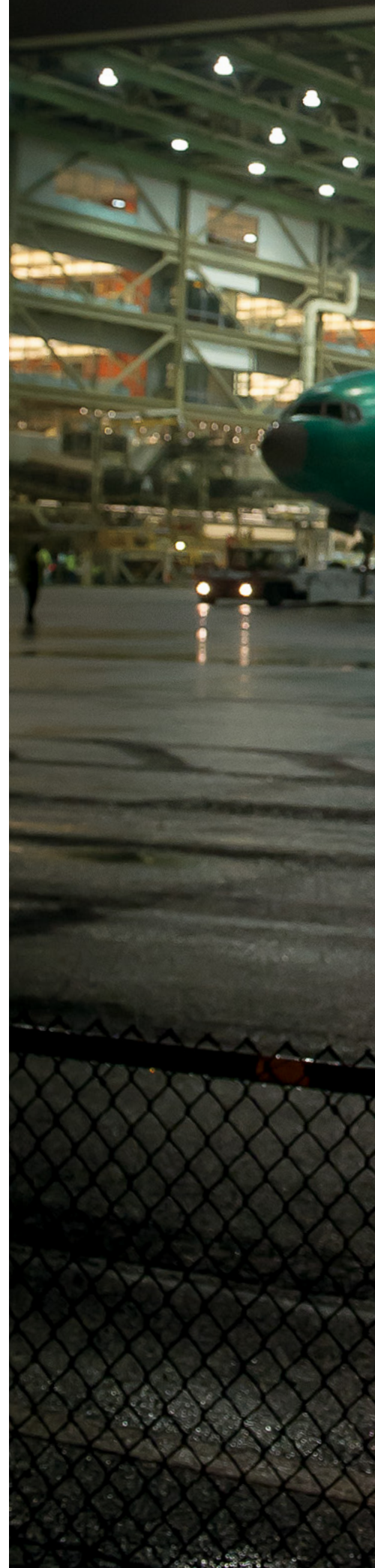
The most difficult thing is the timing and sequencing. It's making sure that everything is prepped so that if something gets out of sequence we can deal with it before it becomes an issue. One mistake down here can snowball and cause a ripple effect that's felt down the line.

You take things you learn from solving problems and turn them into processes. Processes survive challenges. It's the nature of what we do. And flexibility is part of the job description.

This is an interesting place to work because we have bigger "toys" than other people do at their jobs. I like the responsibility of what we do. It's always a little different and it's never boring. ■

DANIEL.W.RALEY@BOEING.COM

For more on how employees move a new airplane out of the factory, see Page 28.



A photograph of Patrick Brislaw, a man with long grey hair and a beard, wearing a yellow safety vest over a dark blue shirt. He is standing in a large industrial facility, likely a Boeing factory, with a large white and teal airplane visible in the background. The ceiling is high with many lights. He has his arms crossed and is looking towards the camera.

Patrick Brislaw

HAS WORKED FOR BOEING:
29 years

TEAM:
777 Tool Construction

HAS BEEN PART OF THE TEAM:
20 years

Patrick Brislaw, shown outside the factory in Everett, Wash., supervises biweekly rollouts of the 777.

PHOTO: BOB FERGUSON | BOEING

HISTORICAL PERSPECTIVE



Dauntless resolve

Douglas dive bomber changed the course of history in decisive naval battle

BY MICHAEL LOMBARDI

On the morning of June 4, 1942, dive bombers from the U.S. aircraft carriers *Enterprise* and *Yorktown* attacked the Japanese navy's prized fleet of aircraft carriers near Midway Island. In five minutes, 11 direct hits and a number of near-misses led to the sinking of Japan's irreplaceable carriers *Akagi*, *Kaga* and *Soryu*; later that afternoon, the carrier *Hiryu* was attacked and followed the other three carriers to the bottom of the Pacific Ocean.

Although the U.S. carrier *Yorktown* also was sunk, the Battle of Midway marked a turning point for the United States in the war in the Pacific, coming only six months after the attack on Pearl Harbor. The decisive victory was made possible by skilled and courageous naval aviators, and a dive bomber known as the SBD (Scout Bomber Douglas) Dauntless from Douglas Aircraft, a Boeing heritage company.

Affectionately called "Slow But Deadly" by its crews, the Dauntless was a product of the Douglas plant in El Segundo, Calif., which came to

Douglas by way of Jack Northrop, who had a long relationship with Donald Douglas, first as an employee in 1923 to 1926.

Northrop had left Douglas to eventually start his own company, Avion, which was bought by Bill Boeing's United Aircraft and Transport Corp. in 1929. When Boeing decided to consolidate Avion with Stearman in Wichita, Kan., Jack Northrop left United Aircraft and approached Donald Douglas for assistance in starting Northrop Corp., with Douglas holding 51 percent ownership. In 1937, ongoing labor disputes forced Donald Douglas to dissolve Northrop Corp., creating the Douglas El Segundo Division in its place.

Along with the El Segundo plant came famed designer Ed Heinemann, who had designed the Northrop BT-1 and was working on a more advanced version, the XBT-2, which became the prototype for the Dauntless.

The first production Dauntless flew on May 1, 1940. The airplane had a crew of two—a pilot and a gunner who manned a single and later a pair of rear-facing .30 caliber machine guns. It could carry a 1,200-pound (550-kilogram) bomb load, with a typical load being a single 1,000-pound (450-kilogram) bomb carried on the centerline and a 100-pound (45-kilogram) bomb under each wing.

The dive bomber also had two forward-firing .50 caliber machine guns. The main production version,

the SBD-5, was powered by a 1,200-horsepower Wright R-1820 engine and had a top speed of 255 mph (410 kilometers per hour) and a range of 1,565 miles (2,520 kilometers).

While the Dauntless had a conventional appearance, it did have one feature that set it apart: massive dive brakes. Perforated hinged split flaps deploying both above and below the trailing edge of the wing allowed the pilot to take careful aim while attacking in a 70- to 75-degree dive.

Serving primarily with the U.S. Navy and Marine Corps in the Pacific, the Dauntless also participated in the invasion of North Africa and other combat operations in the Atlantic. Designated the A-24 and named Banshee, it also served with the U.S. Army, seeing combat in the South Pacific.

In 1943, the Navy had planned to phase out the Dauntless in favor of the Curtis SB2C Helldiver, but teething problems delayed introduction of the Helldiver and the Dauntless served on until 1944. The rugged Dauntless also was delivered to allied nations, including Great Britain, New Zealand, France and Mexico. In all, Douglas delivered 5,936 SBD and A-24 dive bombers.

Today, only two dozen SBDs survive. But to see one, all that is needed is to pass through one of America's busiest airports—Chicago's Midway. There, an SBD Dauntless hangs in the concourse as a memorial to that famous battle the airport is named for, a reminder of the sacrifice and courage that changed the course of history on June 4, 1942. ■

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Photos: (Far left) These early production SBD Dauntless aircraft wear an overall light gray finish, which was standard until August 1941, when a U.S. Navy directive called for the upper surfaces to be painted blue-gray. (Left) The perforated dive flaps of the Dauntless can be seen on a factory-fresh SBD-3 parked on the ramp of the Douglas plant in El Segundo, Calif. **BOEING ARCHIVES**



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Building it better— and safer

Advanced manufacturing
shapes the future across
Commercial Airplanes

BY ERIC FETTERS-WALP | PHOTOS BY BOB FERGUSON

This is the first in an occasional series on advanced manufacturing technology and the tools and processes designed to help employees make Commercial Airplanes products in a safer and more efficient and productive way, with more consistent quality.

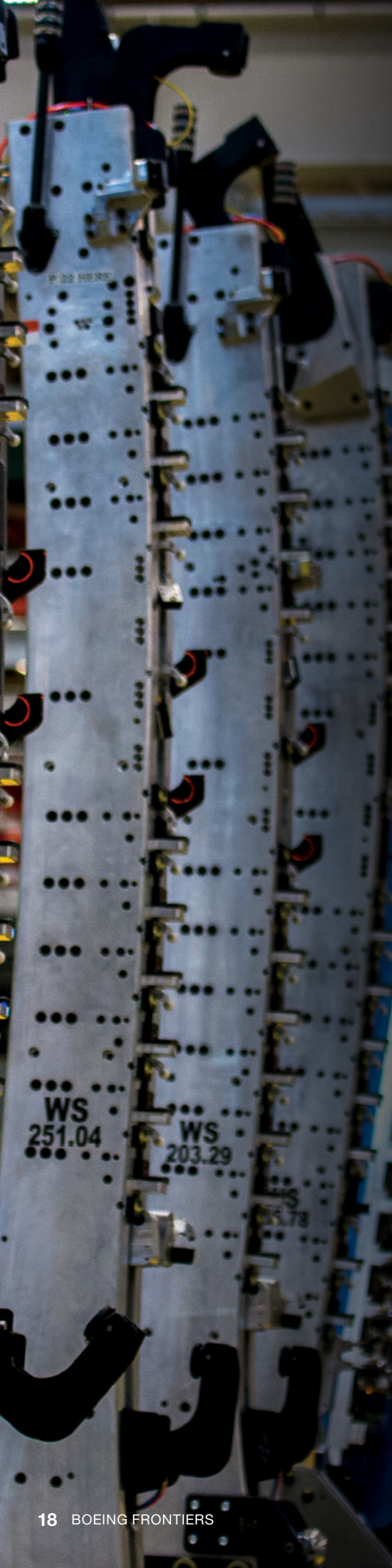
Drilling fastener holes by hand up and down the curves of an airplane fuselage section involves working at odd angles while trying to be as accurate as possible.

On a routine morning in the Everett, Wash., factory, Ron Masset and Rick Anthony, both mechanics with the 777 program, show a newer way the task can be done. They set up the

Photo: From left, Larry Fudge, lead operator; Pat Tomas, Quality Assurance inspector; Sam Dobbs, equipment engineer; and Kurt Bayer, equipment services mechanic, inspect functionality on the wing panel assembly line tool in Renton, Wash.







Flex Track tool, which uses flexible rails that hug the curved sides of the airplane's fuselage.

After the rails are in place, a programmable tool slides up and down to drill hundreds of precise fastener holes. The two mechanics monitor the automated drilling machine's progress, instead of laboriously drilling the holes themselves. But they don't seem to miss that part of the job.

"The ergonomics are much better than drilling by hand. And with this, there's better quality and improvements in safety and production," Masset said.

Boeing Commercial Airplanes is adopting advanced manufacturing tools and processes across its production and fabrication sites as a way to produce more consistent quality, prevent repetitive motion injuries and safety problems, and reduce long-term costs.

In some cases, new technology is replacing tools and processes that have been used since the early years of the jet age. It's a natural progression, said Walt Odisho, vice president of Manufacturing and Safety for Commercial Airplanes and companywide leader of Operations.

He pointed out that other business sectors, most notably the automotive industry, already use much more automated manufacturing than Boeing.

"As we see more and more competition in aerospace, I think we feel the need for it more urgently," Odisho said. "Advanced manufacturing represents the best practices we can adopt in terms of processes and machines in order to make our product in a safer, more productive way."

Among other things, that means using technology to assist with more injury-prone tasks. It also means making production tools and systems that can be more flexible and programmable, Odisho said.

Flex Track, in use for several years on Boeing's various commercial airplane and military aircraft production lines, represents the early generation of advanced manufacturing tools. In Renton, Wash., the 737 wing panel assembly line, known as PAL, gives a



glimpse of the next generation. By May of next year, nine PAL machines will be placed inside the 737 wing facility, each able to fasten stringers to wing-skin panels at twice the rate of the previous method, which used a combination of machines and manual labor. The new systems, which already are being used to build the first production wings, are designed to help the 737 and future 737 MAX lines as production rates increase.

The machines reduce the number of steps, many involving manual work, said Brian Stewart, project manager for the PAL. Part of that process, he said, had not changed much since the 1960s.



“We took all those things, eliminated most of the manual work, and made it more efficient,” Stewart said. “This isn’t about getting rid of any jobs. It’s about how to do this safer and better.”

Setting up the new PAL machines requires mechanics to learn more about computer programming, said Larry Fudge, a lead operator in the 737 wing production area. In this early phase, as the PAL machines are being installed, adjusted and tested, he compared the learning curve to “drinking from a fire hose.” Fudge predicted the transition will be easier in the future for employees, as there

will be more training opportunities available. Some of the production improvements brought about by advanced technology are on a smaller scale than the large PAL machines.

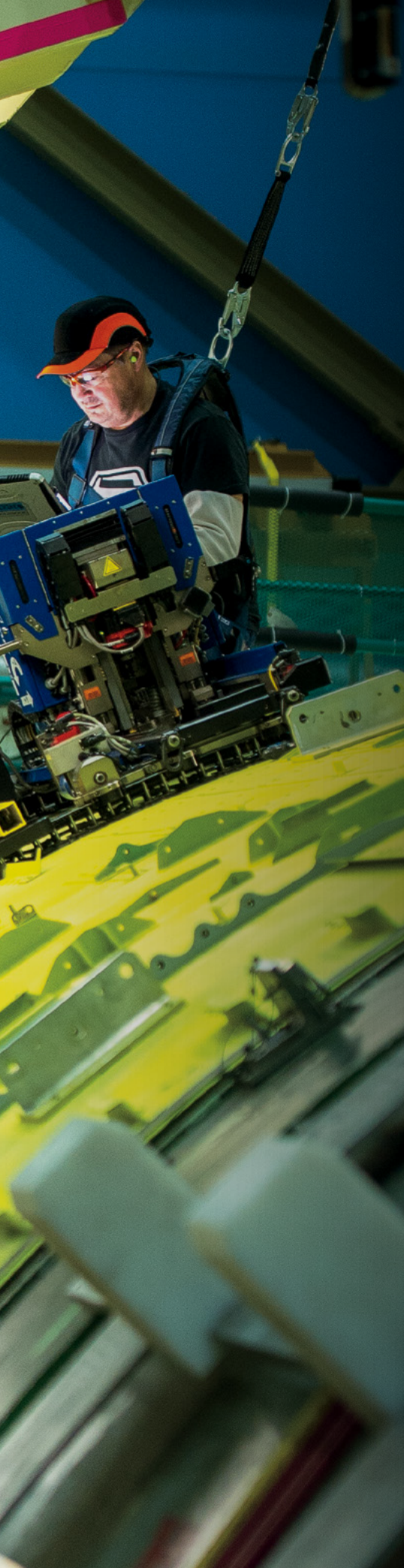
At Boeing’s Fabrication site in Auburn, Wash., for example, a team with the Tube, Duct and Reservoir Center recently used design software and computer-numerical-controlled milling machines and lathes to improve the production of a small but critical 777 part—the tee duct.

Mechanic Matthew Murray said the tee duct, which delivers hot air to prevent icing on the airplane’s wing,

always has been challenging because of its shape, and that it has to be fashioned out of titanium. It took about 90 minutes to machine the duct under the old process, which also presented safety and ergonomics issues. Now, he said, it takes about 10 minutes to create the tee duct with a computer-controlled machining process that has improved quality by 35 percent and is safer and

Photo: Project manager Brian Stewart, left, and Glynis Pacheco, industrial engineer, review the build plan and sequence of work on a wing panel produced on the panel assembly line in Renton, Wash.





more ergonomic for employees.

The improved safety aspect of the new manufacturing tools and processes isn't incidental, said Mary Sullivan, chief engineer for Boeing Fabrication Production Engineering.

"The majority of all injuries can be eliminated by designing for safe manufacturing. It begins with spending more time in the production areas listening to the operators we support. We then create designs, build plans, tools and equipment to implement advanced manufacturing," Sullivan said. "In the areas where we have applied advanced manufacturing, we are seeing a significant reduction in injuries, as well as improvements in quality and productivity."

But much more is coming. The cutting-edge future of advanced manufacturing is the Fuselage Automated Upright Build (FAUB), which uses programmable robots to drill holes for and install approximately 50,000 fasteners on fuselage sections—a repetitive job done by hand today. The repetitive stress is hard on people's shoulders and hands, and this new technology will significantly improve ergonomics, eliminating this stress, according to Sullivan. This precision drilling also improves quality in the build process. FAUB will be used for the first time on the 777 and the 777X.

A 200,000-square-foot (18,600-square-meter) addition on the east end of the Everett factory will house FAUB systems to put together sections of both planes.

"Advanced manufacturing—like FAUB—is helping us transform our production system to maximize our competitive advantage," said Jason Clark, vice president of operations for the 777 and 777X programs. "It'll be used soon on today's 777, and later on tomorrow's 777X, helping to propel production into the future."

With other industries already ahead of aerospace in advanced manufacturing processes, it is time to put aside hesitation and move forward, Odisho added. But he acknowledged that as advanced manufacturing technology and processes improve, so can employee

anxiety about the future of the human workforce. Automation, however, can't replace the innovative and flexible decision-making that employees bring to their jobs, Odisho said.

"There's no better design than the human capacity to respond to situations quickly," Odisho said. "If our goal was to just replace all people with machines in production, we'd be bound to fail."

The new way of making the 777 tee duct, for example, underscores just how important employees are to advanced manufacturing. Murray, the team lead, pointed out that it took his team's ingenuity and repeated trial and error to perfect the production process. "Regardless of the amount of advanced technology we have at our disposal, the one resource that we cannot purchase is our team's continuity, tenacity and expertise," he said. "Without this, the advanced technology is rendered inoperable."

At the same time, employees also say they see the benefits, for themselves and for Boeing, of advanced manufacturing tools and processes.

"It's going to happen," said Anthony, one of the 777 mechanics. "Everyone is switching to it, and you get consistent production times and good quality."

Murray echoed that, saying his team, which programs computer-controlled machines, sees many opportunities where advanced manufacturing can make a difference.

"In my opinion, people in the company today have the opportunity to utilize advanced manufacturing tools and processes far greater than any other time in the history of The Boeing Company," Murray said, "and the need has never been greater for them to do so. We need to back them so we can ensure their success." ■

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Photo: Structure mechanics Ricky Anthony, left, and Ron Masset, top, set up a Flex Track automated drilling machine on a 777 fuselage in the Everett, Wash., factory.



Italy is one of Boeing's most important partners in Europe

BY DAN RALEY

Italy is a country filled with curiosity and discovery. For centuries, this southern European nation has helped shape the rest of the world with its inquisitiveness—whether it was explorers such as Marco Polo or fellow Italians in modern times establishing the latest trends in fashion, cuisine, automobiles and the arts.

It's not surprising, then, that similarly inventive Boeing and Italy have maintained an aerospace

relationship going on many decades.

A DC-2 built by Boeing heritage company Douglas Aircraft was used for commercial and military purposes by Italy before and after World War II, but the partnership began in earnest in 1950 with Avio Linee Italiane operating a DC-4 airliner. Today, ongoing collaborations between Italy and Boeing involve operation of the KC-767 tanker and production of 787 Dreamliner fuselage barrels and other key structures, and more.

"Italy is a high-innovation society," said Marc Allen, president, Boeing International. "They've demonstrated an ability to create, and to create with



excellence, in a number of fields. One thing we're working on as a company that is growing its presence and global partnerships is how do we together continue to press for excellence in aerospace on a global standard?

"That's certainly something we're pursuing and exploring with Italy, and with many other countries."

Boeing and Italy enjoy an aviation partnership as unique as any. While the 777 is the flagship airplane for the country's largest airline, Alitalia, which operates 10 of them, Boeing equips every branch of the Italian military service with a variety of aircraft and enlists Italian suppliers to provide

parts for three different twin-aisle jetliners, foremost the 787.

Italy, which is hosting the global Expo 2015 in Milan through October, holds the distinction as one of Boeing's first international partners after it agreed in 1978 to help design and build the 767. Boeing now supports more than 13,000 jobs in Italy and last year spent \$1.8 billion on its Italian-based suppliers. The company is so ensconced in the fabric of this 736-mile-long (1,180-kilometer-long) country that aviation brand names have been blurred, according to Roberto Russo, information technology computing lead, Boeing International.

"I can remember my grandparents—when they spoke about aircraft, they spoke about Boeing," Russo said. "Even if it was a different company, they said Boeing. It's strong—the perception of the man on the street in Italy—that Boeing equals aircraft."

In southern Italy, Alenia Aermacchi, a subsidiary for Italian aerospace company Finmeccanica, builds 14 percent of the 787 Dreamliner airframe—two midfuselage sections, as well as the horizontal stabilizer. The composite

Photo: Milan is hosting Expo 2015, shown here with Sforza Castle in the background. SHUTTERSTOCK



Strengthening Boeing's roots

Boeing not only maintains aerospace relationships with Italy; it readily encourages the country's next generation to get involved in science, technology, engineering and the environment.

Through a series of Global Corporate Citizenship programs, the company and local partners have reached out to more than 130,000 Italian students of all ages and shared different educational and environmental concepts.

"Our interest was to increase and build awareness in the children who will be leaders in the future," said Armida Balla, a Boeing government-relations specialist in Rome and Global Corporate Citizenship liaison.

Boeing, initially teaming with supplier Alenia Aermacchi in 2008, has showed 32,000 university and high school students in southern Italy's Puglia region—a heavy manufacturing area in which production of 787 Dreamliner fuselage sections and horizontal stabilizers is based—what a business

plan was and how to create one, plus how to work in a business environment.

Called *Natural..mente scuola*, which means "naturally, school," or "school, of course," the program was considered such a success that it led to a second program involving an even younger Italian audience with a larger reach. Beginning in 2010, Boeing connected with 100,000 students from elementary and secondary schools hailing from 20 regions across Italy.

The response from the younger students to topics not typically addressed in the local school systems was enthusiastic, providing Boeing with a unique connection across the European nation, according to Balla.

"These programs are really strengthening our roots in the country," Balla said. "They create value, Italian texture. They allow us to be an innovative partner and company." ■

fuselage parts are constructed in one of the largest manufacturing plants in the country, a sprawling building that covers 753,000 square feet (70,000 square meters) near the town of Grottaglie. Using a 10,000-foot (3,050-meter) runway lengthened to accommodate the large scope of work, those fuselage sections manufactured in Grottaglie are loaded onto the modified 747 Dreamlifter and flown to Boeing South Carolina in North Charleston, where employees install systems and wiring and attach a 787 fuselage section produced in Japan.

The airfield is shared with the Italian navy and its fleet of AV-8B Harriers—jet fighters assembled by Alenia using kits supplied by Boeing heritage company McDonnell Douglas, a past Boeing and Italian collaboration.

"Italy is one of the most important partners we have in Europe," said Antonio De Palmas, Boeing Italy president. "This is based on presence, supplier base, installed base and relationships. One reason we have such a strong presence is that Italy is one of the most open

markets in the world for Boeing."

It begins with the country's multitude of defense needs. Boeing built four KC-767A tankers for the Italian air force and provides customized support services, plus provides precision airstrike weaponry such as the Joint Direct Attack Munition (JDAM) and the Small Diameter Bomb through a partnership with Italian industry. The Italian Army has received four of the 16 CH-47F Chinook helicopters being jointly produced for it in Italy through 2017 by Boeing and AgustaWestland, another Finmeccanica subsidiary. The advanced "F" model is replacing Italy's CH-47C fleet, in use for four decades. Italy is a customer for the ScanEagle unmanned aircraft system of Boeing's subsidiary Insitu.

Boeing also provides Italy with military satellites and launch services, and partners on ground-based training and support systems for jet-fighter trainers, advanced cybersecurity solutions, a naval ship-to-shore connector program and robotics.

"As the world's premier aerospace company, Boeing carries a certain

amount of prestige in Italy," said Oris Davis, director, Boeing International Business Development, Southern Europe. "More important, we have a proven track record of successfully establishing partnerships with national industry."

The KC-767 tanker is an example of Boeing-Italian collaboration. Boeing supplies a 45-person team that handles all Italian tanker maintenance work at Pratica di Mare Air Base near Rome under a performance-based logistics contract. Most air forces prefer to keep some or all of these responsibilities in-house.

Boeing has nearly 300 employees in Italy, shifting from expatriates to primarily Italians, and the country continues to explore local prospects and markets there, according to Paolo Scialanga, manager, Boeing

Photo: Students from the Boeing-supported *Natural..mente scuola* program tour the Alenia plant in Grottaglie, Italy. Production was suspended to accommodate the large event. **GIOVANNI SQUITIERI**

‘Connecting the world’

Over the next six months Italy will host Expo 2015 in Milan, while Boeing offers sponsorship support.

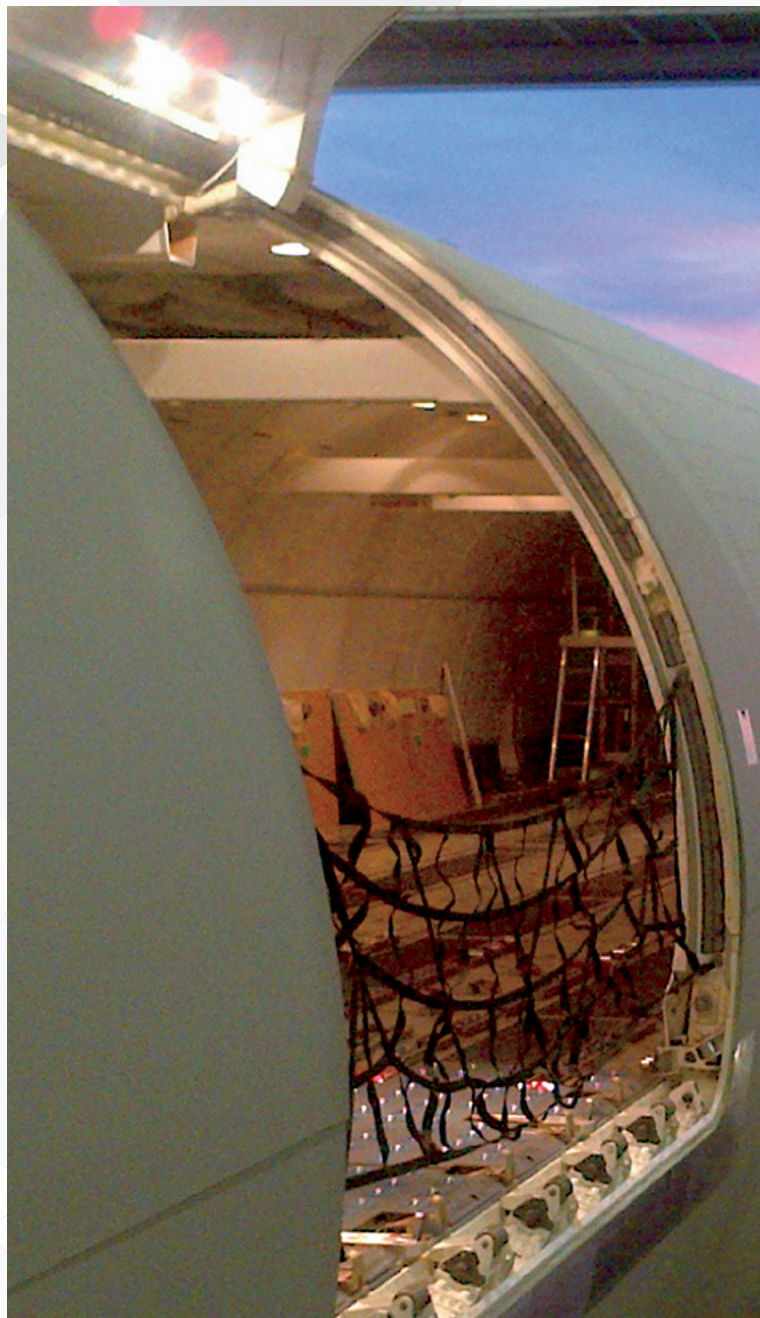
Representatives from 140 countries will gather in the northern Italian city through Oct. 31 for an event called “Feeding the Planet, Energy for Life”—sharing their different cultures, technologies and traditions. Organizers expect the Expo activities, international pavilions and bioclimatic greenhouses to attract up to 25 million visitors.

“The Expo is all about connecting the world, and, of course, that’s what we do,” said Marc Allen, Boeing International president.

Boeing, which will support the U.S. pavilion with technology that explains its latest advances in aerospace fuel consumption and emissions, considers participation in Expo 2015 a natural step.

“It’s a chance to showcase Boeing,” said Antonio De Palmas, Italy Boeing president. “We have a great story on how aviation and the environment are progressing.”

The world’s fair is the second for Milan, which hosted World Expo 1906, one highlighting the completion of the Alpine Tunnel of Sempione that connected the city by rail to Paris and stamped Milan as Italy’s industrial capital. ■



International Business Support.

“We are perceived more and more as a company heading toward globalization and eyeing more locally hired employees for the long term,” Scialanga said.

Rosario Esposito recently was named vice president, Supplier Management of Italy.

Europe remains a region of high importance for Boeing, according to Allen. While economic growth across the continent has been challenged in recent years, commercial airplane projections show considerable promise through

2033, Boeing’s *Current Market Outlook* indicates. European countries are expected to order 7,450 aircraft over that time, trailing only Asia Pacific (13,460) and North America (7,550), and generate about \$1 billion in market value, second only to Asia Pacific (\$2 billion).

Italy, as Europe’s fourth-largest economy, will play a vital role. “We’re going to see as much business across Europe as we’ll see in the United States for the next 20 years,” Allen said.

Among the airlines serving the country, national carrier Alitalia last

year attracted a significant investment from Etihad Airways of the United Arab Emirates, traditionally a strong Boeing customer, which could bode well for future jet sales, noted Ryan Rubenstein, Boeing Commercial Airplanes sales director for Italy and Israel. Meridiana, Italy’s second-largest local carrier, has announced plans to go with an all-Boeing fleet, while two smaller carriers, Blue Panorama and Neos, also operate all-Boeing fleets. Neos, affiliated with an Italian tour operator, will become the first Italian



carrier to operate the 787, leasing at least three of them, beginning in 2018.

“A significant piece of the 787 is built in Italy and we’re very proud to now have an Italian carrier committed to flying that airplane,” Rubenstein said.

Crossover is a constant in Boeing-Italian dealings. Boeing has worked for 25 years with central Italy supplier Umbra Cuscinetti, which makes ball screws used in airplane flaps. Umbra now operates a subsidiary office in Everett, Wash., less than a mile from the Boeing factory.

“Umbra is family-owned and has

a long-term commitment to aviation, and companies that have a long-term view are more consistent with our needs and expectations,” said Kent Fisher, vice president and general manager, Commercial Airplanes Supplier Management.

Boeing and Italy maintain a seamless connection, one built through defense and commercial sales, plus supplier partnerships that entice a company such as Umbra to the U.S. and collaborations that put Americans to work in Rome and other parts of the country.

“We value Italy’s openness and the partnerships we have there, and we invest in those partnerships,” Allen said. “They are an important model for others around Europe and the world.” ■

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Photo: Boeing has delivered four KC-767A tankers to the Italian air force and supplies a 45-person team to help service them. **IVANO DI DOMENICO**

NIGHT MOVES

Moving a huge new jetliner out of the factory is more than a day job

BY DAN RALEY | PHOTOS BY BOB FERGUSON

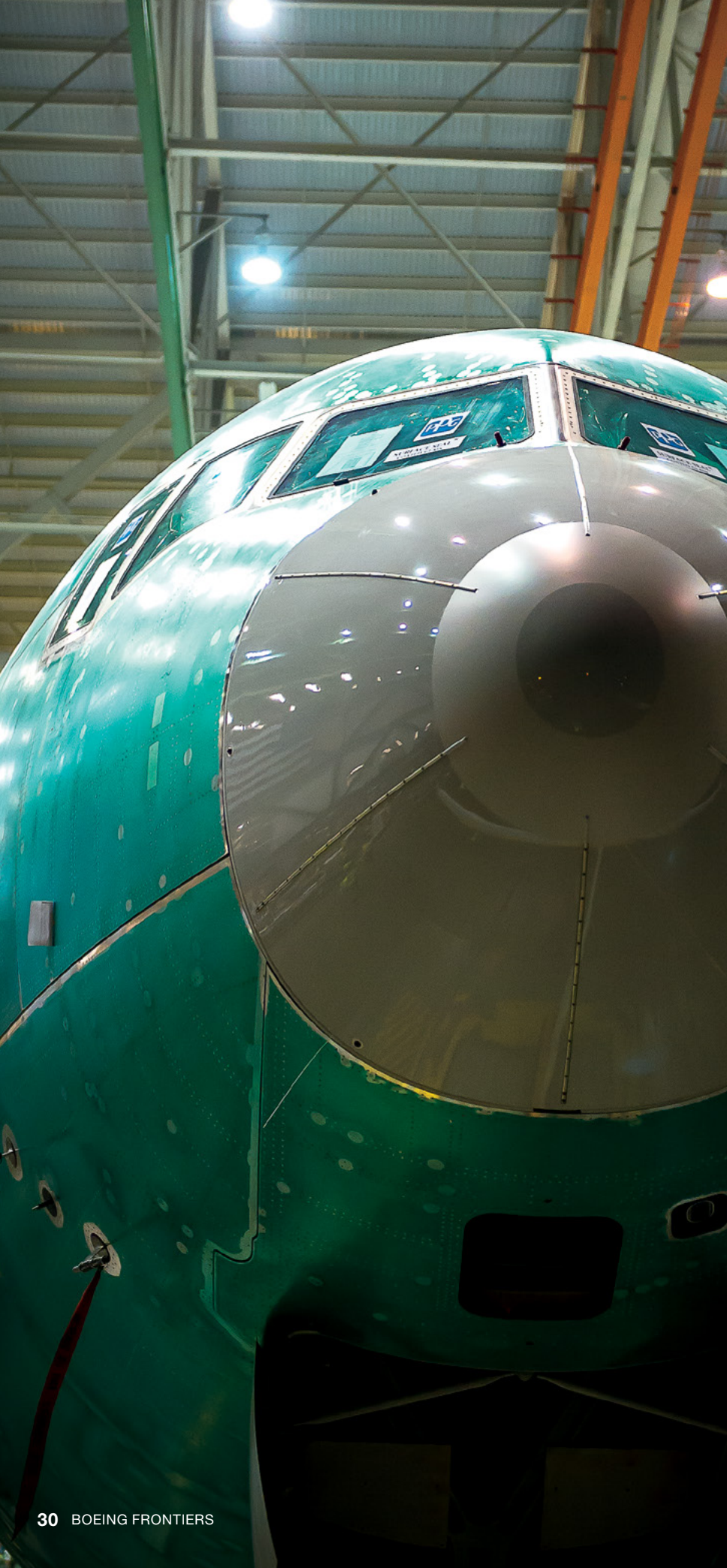
The new 777 jetliner is parked inside the final-assembly plant in Everett, Wash., surrounded on all sides. Work-stands hug much of the fuselage. Portable stairways align with open passenger and cargo hatches. Hydraulic hoses and electrical cords connect to the underbelly. Trash containers, parts tables and stepladders fill whatever space remains.

It doesn't seem possible, but this plane is departing in 40 minutes.

What happens next is not unlike an anthill, where everything suddenly turns busy yet purposeful. Employees on beeping forklifts begin removing equipment. Others use hand-held keyboards to systematically lower and steer heavy platforms off to the side. Yet others, ever mindful of their surroundings, carry off parts

Photo: A 777 leaves the factory in Everett, Wash., a process that takes place twice weekly.





on foot. In an instant, it's all gone.

This flurry of activity for the 777 happens every Monday and Wednesday night—a process that is responsible for sending a fully assembled airplane to the outside world. This is a factory rollout.

“It’s like a dance, like a choreographed dance,” said Burney Andersson, a mechanic and provisioner, the latter title describing a moving-line services provider.

In this case, each employee is paired with a 150-ton (140-metric-ton) dance partner, requiring extra nimble steps. Great care must be taken when squiring around a 777.

“Everything counts when you’re moving these airplanes,” said Bob Faford, another provisioner who operates a small tug. “You have to watch everything. You can’t hit anything. These jets damage like cars, but you can’t just take them



down to the body shop to fix them.”

The 777 line move actually begins at 2:30 p.m., with tasks assigned using Lean+ disciplines. While just one of these planes typically exits the factory at a time, three or four others must be advanced forward on the factory floor, requiring restaging for each one.

“There are a lot of things that get moved with a few bodies to do it,” said Jill Klages, a materials processor, or parts mover. “It’s like a marathon for us.”

At 8:20 p.m., while employees begin retrieving the imposing collection of equipment set up around the departing jet, security personnel walk the outside route and check for anything that might get in the way. They will remove four stop signs and lower more than 50 yellow bridge railings to allow

engine clearance for the 777.

By 8:45 p.m., the factory’s massive doors slide open on three separate tracks and a thick, low-slung tug driven by Site Services’ material handler Mark Ginnis pulls up to the entrance.

“My job is pretty crucial,” Ginnis said. “I have to be focused and I turn off the radios. Once I hook onto it, it’s my plane.”

At 9:02 p.m., a siren sounds in five short blasts, giving the “all ready” signal, and the tug moves into position, connecting with the 777’s nose landing gear. The jet is slowly towed forward and out the door. Six employees stand on all sides, monitoring the rollout. A Boeing security vehicle with a flashing red light escorts the plane up the road.

At 9:30 p.m., after methodically traveling half the length of the factory

and crossing a bridge, the 777 eases nose-first into an open parking stall. The jet, in varying shades of green protective coating because its parts come from different suppliers, will be tested before it’s painted for delivery to the customer.

The rollout never loses its sense of importance or cohesion.

“I’ve done a lot of things at Boeing, but the line move is like family,” said Doug Butner, 777 operations manager. “Everybody comes together.” ■

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Photos: (Far left) Once the factory doors open, the 777 is ready to depart. (Above) It takes nearly 30 minutes for a 777 to leave the factory and reach the paint hangar.



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Royal Dreams

With 787s in its fleet, Royal Jordanian is set for the long haul—and a superior passenger experience

BY SAFFANA MICHAEL

Distinctive in their gold and gray livery, 787 Dreamliners operated by Royal Jordanian Airlines are easily recognizable as they take off from busy Queen Alia International Airport in Amman, Jordan, headed for regional or international destinations.

Royal Jordanian operates five Dreamliners, with six more scheduled to join its fleet over the next few years. The airline chose the 787 for fleet modernization and to help expand its regional and long-haul network, which includes the Middle East, Europe, Africa, Asia and North America, according to Haitham Misto, president and CEO of Royal Jordanian.

“We are keen to continue the legacy of being a forward-thinking airline,” said Misto, who is a pilot and has flown the 787 on a couple of delivery flights.

Royal Jordanian is delighted with the

operational efficiencies of the 787, the first of which Boeing delivered last year, he said. “There has been a significant difference in our fleet performance and operational costs ever since we started operating our 787s.”

Misto said the Dreamliners also are key to the airline’s focus of providing the best possible flying experience to passengers—with the biggest windows of any current commercial jetliner, LED mood lighting and bigger overhead bins.

Royal Jordanian was the first airline in the Middle East to order the 787, in March 2007. It has long been a trendsetter. In the mid-1970s, it was the first Arab airline to operate flights between the Middle East and New York. Around the same time, the airline hired its first Jordanian female flight engineer, who was also the first Arab woman then to serve as a member of the flight deck. More recently, airlineratings.com named Royal Jordanian one of the top 10 safest airlines in the world for 2013.

The airline, established by the late King Hussein in 1963, prides itself on bringing traditional Jordanian hospitality to the skies. Initially called Alia Airlines, after the King’s eldest daughter and as a symbol of his personal investment in its success, the airline’s name changed to Royal Jordanian in 1986 by royal decree. During its 50-year history, the airline has grown from three airplanes

operating to a member of the One World alliance, with a fleet of 27 airplanes serving 54 destinations globally.

“I want our national carrier to be our ambassador of goodwill around the world and to be a bridge across which we exchange culture, civilization, trade, technology, friendship and better understanding with the rest of the world,” King Hussein said at the time Alia Airlines launched.

King Hussein, himself a trained and enthusiastic pilot, nurtured the airline’s long relationship with Boeing, which dates to 1970. Over the years, the airline has operated the Boeing 707, 720, 727, 747 and, most recently, the 787 Dreamliner.

Judging by the airline’s achievements so far, it has a great future, according to Marty Bentrott, Commercial Airplanes vice president of Sales for the Middle East.

“There is a sense of national pride that was instilled by the late King Hussein back when the airline was launched and you still feel it today,” Bentrott said. “It translates into everything they do, and I’m happy that Boeing has been able to be part of that journey, particularly now, with the delivery of the airline’s 787.” ■

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Photo: A Royal Jordanian 787 at Queen Alia International Airport in Amman, Jordan. **ROYAL JORDANIAN**

MILESTONES



IN FOCUS

Liberty wings

Three Boeing F-15E Strike Eagles and an F-15C Eagle (light gray) from the U.S. Air Force's 48th Fighter Wing fly formation in March over the English Channel, with the famed White Cliffs of Dover in the background. The 48th FW, also known as the Statue of Liberty Wing, is based at Royal Air Force Lakenheath in the United Kingdom.

PHOTO: JIM HASELTINE | HIGH-G PRODUCTIONS



Argonne

Normandy

Midway

The Chosin Reservoir

Khe Sanh

Dak To

Medina Ridge

Tora Bora

Fallujah



These are the places we remember,
to honor the lives of those we'll never forget.

