



# Frontiers

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## Delivering the Dream

The 787 Dreamliner ushers  
in a new era in aviation



# 18 Dream day

It was the day so many had been waiting for—first delivery of the 787 Dreamliner, a game-changing jetliner for the 21st century. On Sept. 26, thousands of Boeing employees and others gathered to celebrate the history-making occasion at the Everett, Wash., plant, while others watched around the world. This photo essay captures some of the excitement and memories of that delivery to launch customer ANA (All Nippon Airways).

COVER IMAGE: IN A DOWNPOUR, BOEING EMPLOYEES ESCORT THE 787 DREAMLINER TO THE FIRST-DELIVERY AREA TO PRESENT THE NEW JETLINER TO ANA PRESIDENT AND CEO SHINICHIRO ITO. BOB FERGUSON/BOEING

PHOTO: AMONG THE MANY INNOVATIONS ON THE 787 ARE NEW FUEL-EFFICIENT ENGINES WITH NOISE-REDUCTION TECHNOLOGY SUCH AS THE CHEVRONS ON THIS ENGINE COWLING EDGE. BOB FERGUSON/BOEING

## Ad watch

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

*Inside cover:*



This ad was created to enhance the image of Boeing in Korea. It showcases key Boeing partnerships with Korean industry. The ad continues a five-year Korean partnership campaign and will appear in local trade publications.

*Page 6:*



This ad was developed to acknowledge the 100th anniversary of civil aviation in India and Boeing's involvement for the past 70 years. Beginning this month, the print ad will appear in the *Times of India*, *Hindustan Times*, *Economic Times*

and *India Today*. An online component to this campaign will air on India websites.

*Pages 10–13:*



“Enduring Force” and “Enduring Security” are two of several ads in a new BDS advertising campaign highlighting the capabilities Boeing brings to its customers. “Enduring Force” focuses on Boeing’s military aircraft expertise, while “Enduring Security” highlights information security capabilities. QR codes, the square black-and-white symbols located on each ad, encourage readers to visit complementary online pages to learn more about Boeing’s capabilities. The ads will appear in print and online business, political and trade publications.



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**Publisher:** Tom Downey  
**Editorial director:** Anne Toulouse

## EDITORIAL TEAM

**Executive editor:**  
Paul Proctor: 312-544-2938

**Editor:**  
James Wallace: 312-544-2161

**Managing editor:**  
Vineta Plume: 312-544-2954

**Art and design director:**  
Brandon Luong: 312-544-2118

**Graphic designer:**  
Cass Weaver: 480-216-4539

**Photo director:**  
Bob Ferguson: 312-544-2132

**Commercial Airplanes editor:**  
Don Smith: 206-766-1329

**Defense, Space & Security editor:**  
Diane Stratman: 562-797-1443

**Engineering, Operations & Technology editor:**  
Junu Kim: 312-544-2939

**Human Resources and Administration editor:**  
Geoff Potter: 312-544-2946

**Shared Services Group editor:**  
Beriah Osorio: 425-577-4157

**Staff writer:**  
Eric Fetters-Walp: 425-266-5871

## ONLINE PRODUCTION

**Web manager:**  
Wendy Manning: 312-544-2936

**Web designer:**  
Michael Craddock: 312-544-2931

**Web developers:**  
Lynn Hesby: 312-544-2934  
Keith Ward: 312-544-2935

**Information technology consultant:**  
Tina Skelley: 312-544-2323

## HOW TO CONTACT US:

**E-mail:**  
boeingfrontiers@boeing.com

**Mailing address:**  
Boeing Frontiers  
MC: 5003-0983  
100 N. Riverside Plaza  
Chicago, IL 60606

**Phone:**  
312-544-2954

**Fax:**  
312-544-2078

**Web address:**  
www.boeing.com/frontiers  
Send all retiree address changes to  
Boeing Frontiers, MC 3T-12  
P.O. Box 3707  
Seattle, WA 98124-2207

**Postmaster:** Send address corrections to  
Boeing Frontiers, MC 3T-12  
P.O. Box 3707, Seattle, WA 98124-2207  
(Present addressees, include label)

# table of contents



14

## A ray of sunshine

The roof of the new Boeing South Carolina Final Assembly building in North Charleston, where 787 Dreamliners will be assembled, features one of the largest rooftop solar installations in the southeastern United States. The 18,000 solar panels will generate about 20 percent of all the electrical power required by the Boeing South Carolina site. PHOTO: ALAN MARTS/BOEING



34

## Back to nature

Wind, sunshine and native vegetation are all playing key roles in helping Boeing clean up a landfill site in Wichita, Kan. The sustainable remediation effort includes the use of cottonwood trees, alfalfa and a windmill-powered water pump. But modern technology has not been abandoned entirely. A solar-powered water pump is also part of the project. PHOTO: BEVERLY NOWAK/BOEING



36

## Ideal market

In recent years, South Korea has been one of Boeing's top and most consistent markets for both Commercial Airplanes and Defense, Space & Security. Boeing products are the backbone of the Republic of Korea Air Force, with two more military aircraft competitions on the horizon. And South Korea is a customer for three of Boeing's newest commercial airplane models. PHOTO: ASSOCIATED PRESS



30

## Long live the queen

Boeing employees who designed and built the first 747 are known as the "Incredibles" for what they were able to accomplish. The new 747-8, the biggest commercial airplane that Boeing has ever built, extends that legacy of excellence. It features significant improvements in range, payload, environmental compliance and noise reduction. PHOTO: BOEING



44

## What's up

Fifty years ago, aviation pioneer Howard Hughes formed a company to make satellites at an El Segundo, Calif., plant that had been used for making cars. Today it is the Boeing Satellite Development Center—the world's largest satellite factory. PHOTO: BRYAN BERETTA/BOEING

## INSIDE

### 07 Leadership Message

Airplane development programs are never easy, and that was certainly the case with the 787 and 747-8. But in the end, the best of Boeing overcame some of the most complex aviation challenges in history. The results are two new airplanes that will help define the second century of flight, according to Jim Albaugh, president and chief executive officer of Boeing Commercial Airplanes.

### 08 Snapshot/Quotables

### 09 Why We're Here

### 47 Milestones

### 50 In Focus



## ONE PARTNERSHIP. ENDLESS POSSIBILITIES.

100 years ago, civil aviation dawned in Indian skies. And for 70 years, India and Boeing have partnered to help India's dreams soar. Today, this partnership fuels India's connectivity and self-reliance. Fast tracking the nation's economic prosperity, the possibilities for growth and partnerships are, indeed, endless.



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# Delivering the future

### Boeing defines the second century of flight with the 787 Dreamliner and 747-8

At every turn over the past few months, the Commercial Airplanes team has demonstrated what I tell people wherever I go: Boeing is a great company that does great things.

This month's magazine highlights some outstanding examples. With delivery of the 787 Dreamliner and completion and certification of the 747-8 Freighter, Boeing has written a new chapter in the history of aviation. (See Page 18.)

Credit goes to the amazing people on these two programs, the extraordinary contributions they make each and every day, and the unwavering support they have received from colleagues across the company.

This landmark achievement, so many years in the making, reflects the things that have made Boeing the company it is today: innovation, excellence in engineering and manufacturing, and keen attention to the needs of customers.

Creating any new airplane is a monumental undertaking, and it's no secret that the path on these programs was neither smooth nor easy. The journey on development programs seldom is.

In the end, we brought the best of Boeing to some of the most complex aviation challenges in history—and that's something we can all take pride in.

These airplanes position us well in a dynamic and growing market. Over the next 20 years, we're forecasting a need for 33,500 new airplanes. That's a \$4 trillion market. And we're not the only ones after it. New and aggressive competitors are reshaping what has long been a duopoly between Boeing and Airbus.

Nearly half of that \$4 trillion opportunity is in the single-aisle segment. That's why we're making the world's best—and best-selling—jetliner even better by re-engining the 737.

We're calling that aircraft the 737 MAX because it maximizes fuel efficiency, reliability, maintainability and passenger comfort. (See Page 8.) Our direction in this market—and the decision to re-engine rather than design and build an all-new airplane—has been confirmed by the response we've gotten from customers. We have more than 500 order commitments to date.

When the MAX enters service in 2017, it will have the lowest operating costs in the single-aisle market.



*"We brought the best of Boeing to some of the most complex aviation challenges in history—and that's something we can all take pride in."*

— Jim Albaugh

*President and chief executive officer  
Boeing Commercial Airplanes*

PHOTO: BOB FERGUSON/BOEING

As I meet with customers around the world, they tell me they're after three things. They want to increase profitability, improve fuel efficiency and reduce their environmental footprint.

Our airplanes help them meet all three of these needs.

With such strong demand in the market, we've had to manage our large and growing backlog of orders. We're raising production rates across the board to burn down that backlog and get our airplanes where they belong—into the hands of customers.

There are sure to be challenges along the way. But I'm certain our team will overcome them with the same grace, resiliency and perseverance they have shown time and again. In the meantime, let's celebrate all that we've achieved and recognize that Boeing is defining the second century of flight—just as we defined the first. ■



**GOING TO THE MAX:** The 737 MAX is shown flying near Mount Rainier in Washington state in this illustration. Boeing's board of directors in late August approved the formal launch of the airplane, which will have new and more fuel-efficient engines and incorporate changes that build on the strength of the popular Next-Generation 737. Boeing launched the program with 496 order commitments from five customers. Deliveries are scheduled to begin in 2017. PHOTO ILLUSTRATION: BOEING

Quotables

“ScanEagle was locating contacts of interest that no one else could find.”

– U.S. Navy Lt. Nick Townsend, ScanEagle detachment officer in charge, in a statement about how the Boeing drone assisted U.S. and NATO forces during a 72-hour counter-terrorism mission in Libya, providing intelligence, surveillance and reconnaissance support. Defense Daily International, Aug. 19

“Days like this remind us how special what we do is.”

– Stuart Sausedo, a final assembly mechanic at Boeing South Carolina, when he and his teammates received the aft-body and midbody fuselage sections for the first 787 Dreamliner, which will be delivered from the North Charleston facility next year. Boeing News Now, Aug. 24



Special delivery

New HR service centers give employees the personalized help they need

By Allison Zertuche

As a Human Resources Service Delivery project lead for Boeing Commercial Airplanes in Everett, Wash., Allison Zertuche helped open eight of the company's 57 HR Service Centers. In this *Frontiers* series that profiles employees talking about their jobs, Zertuche discusses how the centers combine with TotalAccess to get employees the HR help they need, when they need it.

PHOTO: BOB FERGUSON/BOEING

The satisfying thing about Human Resources is the direct impact we have on employees. We make their lives a little easier. I mean, you can't do your job well if you've got a lot of questions buzzing around your head, unanswered.

Until mid-2010, I was supporting 747 engineers, and then I was recruited to help with Human Resources Service Delivery at our site. I do miss my engineers, but I'm really loving my current assignment.

For the past year I've been working on opening HR Service Centers—a key aspect of HR Service Delivery. The centers are places where employees can walk up and get their questions answered.

The centers are staffed by HR coordinators and generalists. They provide personalized, one-on-one service to help employees resolve issues and answer questions about all kinds of HR topics—everything from pay and benefits to leaves of absence to the retirement process, even career development and training opportunities. And if a service center staffer can't answer your question, he or she will quickly get in touch with someone who can.

HR Service Delivery is all about balancing high-tech with “high-touch” service. While TotalAccess is a great resource for

HR information and transactions, sometimes people need more guidance on complex issues. Our job is to give managers and employees the help they need when they need it, so they can go back to their jobs knowing that their issue has been taken care of.

These centers have come to life, but there's a lot more to do to keep them going strong. We're tracking metrics and analyzing feedback so we can keep making improvements and exceed customer expectations. For example, if employees don't have time to visit a service center in person, they can email us or call us or even use instant messaging to get the help they need.

I'm passionate about HR Service Delivery, and I'm excited to see where we can take it. I love working here. Getting to walk out into the factory and stand right next to our products is incredible.

I've always wanted to make an impact and add value, and in this role I can see the value for the entire company. ■

allison.r.zertuche@boeing.com

Employees can find the locations and hours of service centers at: <http://hr.web.boeing.com/index.aspx?com=50&id=1>

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# Shine on

Boeing South Carolina turns to the sun as it looks to a renewable energy future **By Rob Gross**

When the first 787 Dreamliner rolls off of the Boeing South Carolina final assembly line in 2012, employees at the North Charleston facility will share immense pride in their historic accomplishment.

But the North Charleston team will be basking in the glow of something else as well—electricity generated by the warm South Carolina sun.

Construction workers are completing installation of a thin-film solar laminate energy generation system on the roof of the Boeing South Carolina Final Assembly building.

It is the largest rooftop solar installation in southeastern United States, as measured by production capacity. And it's one of the 10 largest in the nation. The system, generating enough electricity to power approximately 250 residential homes, will double current solar generation in the state of South Carolina.

"Our renewable energy agreement shows the world how committed we are to sustainable resources and operations. It tickles me pink!" said Hope Gonzalez, an environmental engineer at the site with Environment, Health and Safety.

The solar installation is the feature component of a partnership

between Boeing and South Carolina Electric & Gas, committing to 100 percent renewable energy use at Boeing South Carolina.

The power company will own and maintain the solar installation, which will generate up to 20 percent of the South Carolina site's energy needs. The remainder of the site's energy requirements will be met with renewable energy from the utility's biomass generation facilities, coupled with renewable energy certificates.

"We decided to make this investment in renewable energy at Boeing South Carolina because, from the standpoint of environmental responsibility, it's the right thing to do," said Rick Muttart, director of Site Services for the Midwest and East Region. "We all benefit from preserving the environments where we live and work. A commitment to renewable energy reduces potentially hazardous waste and makes more efficient use of resources."

That commitment has made an impression on those who work at Boeing South Carolina.

"It shows me that Boeing is truly committed to leading the pack when it comes to companies taking responsibility for reducing their impact on the environment," said Chris Eich, Final Assembly and Delivery Quality inspector. "It's important to me because I want to pass down a clean planet one day to my children and grandchildren."

This renewable energy commitment in South Carolina is indicative of how Boeing makes environmental responsibility a priority in every community it calls home.

"Our customers expect that Boeing's products and services be environmentally progressive, and our communities expect that we take credible actions to reduce our impact on the environment," said Mary Armstrong, vice president of Environment, Health and Safety. "The South Carolina site demonstrates that we share those



priorities and shows that it is possible to commit to renewable energy on a large scale."

That message resonates with the workforce.

"Boeing doesn't just talk the talk when it comes to protecting the environment, we walk the walk, too," said Albert Bujak, Final Assembly and Delivery manufacturing planner. "It's our responsibility to preserve what we have, and I'm proud to be a part of the Boeing family that has such high standards." ■

*robert.g.gross2@boeing.com*

**PHOTOS: (Below)** Solar panels are installed on the Boeing South Carolina 787 Final Assembly roof in July. The solar generation system will be operational this month. **ALAN MARTS/BOEING (Insets, from left)** An artist's concept of the completed roof system. **DAVID DANNER/BOEING** Unpacking installation materials; Mark Schwarztrauber, right, Boeing South Carolina project administrator, and Jack Robinson, South Carolina Electric & Gas project manager, review progress; and sections of solar panels are rolled out for installation. **ALAN MARTS/BOEING**

## By the numbers:

**10 acres (4 hectares)**

Surface area covered by solar panels

**18,000 panels**

Number of solar panels

**2.6 megawatts**

Electrical power generated

**20 percent**

Amount of power generated by solar panels for the entire Boeing South Carolina site





# Air bridge to success

*Fast-growing Etihad Airways extends service to new markets*

By **Kathrine Beck**

Having the right fleet of aircraft and a hub at a geographical crossroads has helped make Etihad Airways one of the world's fastest-growing airlines in passenger numbers.

But the carrier's real key to success is "making sure every customer touch point is seamless and hassle-free," said James Hogan, CEO of 8-year-old Etihad, the Abu Dhabi-based national airline of the United Arab Emirates.

This commitment to service has resulted in travel organizations and passengers voting Etihad the World's Leading Airline at the World Travel Awards in both 2009 and 2010.

Abu Dhabi is within an hour and a half flying time from anywhere in the Middle East and three hours from India, a large and growing market. "The Gulf region is a natural air bridge," Hogan said. "Gulf carriers taking advantage of improved-range aircraft have opened up a whole new range of market options."

Etihad operates a fleet of 61 airplanes, with more than 1,000 flights a week serving an international network of 72 destinations in 45 countries in Europe, Asia, North America, Australia and throughout the Middle East. Code share agreements with several of the world's largest airline networks further extend Etihad's reach by allowing airlines to interchange passengers. In 2010, Etihad served more than 7 million passengers.

Etihad has been aggressive in acquiring the efficient, improved-range aircraft vital to its success. At the Farnborough International Airshow in the United Kingdom in 2008, the airline announced a large order, including 35 787-9 Dreamliners and 10 777-300ERs (Extended Range).

Those choices also support Etihad's service commitment.

"The efficiency of these two airplanes will allow us to extend service to markets that would not be economical with other airplanes," Hogan said, "and both airplanes advance our efforts to provide the best passenger experience available on any airline."

Etihad employs close to 8,000 people around the world, representing more than 120 nationalities.

As it continues to grow, Etihad is building the skilled workforce needed to maintain its high standards. The result is opportunities for the people of the United Arab Emirates, where Etihad has recruited and trained 102 cadet pilots, 30 graduate managers and 30 technical engineers. Graduates in all categories include women. ■

*kathrine.k.beck@boeing.com*

**PHOTO ILLUSTRATION:** Etihad Airways is expanding its fleet with more-efficient, improved-range aircraft such as the 787 Dreamliner, pictured here in Etihad livery. BOEING



"Gulf carriers taking advantage of improved-range aircraft have opened up a whole new range of market options."

— James Hogan, CEO, Etihad Airways



PHOTO: ETIHAD AIRWAYS

## Bio-energy: A sight to sea

Etihad Airways is working with Boeing, Honeywell and other partners to pioneer a system using seawater and the desert for bio-energy.

The Sustainable Bioenergy Research Consortium will use saltwater agricultural systems to support development and commercialization of aviation biofuel sources.

The Masdar Institute of Science and Technology will host the project, providing laboratory and demonstration facilities both within and outside of Abu Dhabi's Masdar City, which aims to be the world's first carbon-neutral city.

"The development of carbon-neutral sources of energy is of major importance to Etihad Airways and the aviation industry as a whole," said Etihad CEO James Hogan. "Project findings will be of great use to Etihad Airways as we look to reduce the use of conventional fossil fuels and to develop a commercially viable alternative that also is able to meet the sustainability principles that we have committed to as a member of the Sustainable Aviation Fuel Users Group."

Sustainable biofuel development is a key part of the aviation industry's strategy to reduce carbon emissions.

The Abu Dhabi project will use saltwater to create an aquaculture-based seafood farming system in parallel with the growth of mangrove forests and salicornia, a plant that thrives in salty conditions. This system will convert what would otherwise be problematic aquaculture effluent in seawater into an affordable, nutrient-rich fertilizer for both the mangroves and salicornia. These biomass sources can then be harvested to generate clean energy and to create aviation biofuels and other products.

— Kathrine Beck

# Dream come true

*Delivery of the 787 Dreamliner marks a journey shared by many* Photos by Bob Ferguson

It was raining hard outside the Boeing plant in Everett, Wash. No one seemed to mind.

Nothing could dampen the spirit of the thousands of employees who came together Sept. 26 for this history-making event, along with partners, dignitaries and special guests.

Thousands more participated virtually in a live webcast.

The ceremony marking first delivery of a 787 to launch customer ANA (All Nippon Airways) began with some 500 Boeing employees on the 787 team escorting the airline's



Dreamliner to its delivery position in front of the factory's massive doors.

Among the 500 was Allen Stinnette, one of the lead test engineers for the Boeing Test & Evaluation Systems Integration and Test Labs.

"As we walked in front of the airplane I felt a great sense of satisfaction," Stinnette said. "All of the long days we worked were worth it."

At the end of the procession, employees bowed in unison as a sign of respect for ANA and its president and CEO, Shinichiro Ito.

"ANA showed Boeing a great deal of respect by being patient through our challenges. We honored that by bowing at the ceremony," noted Ted Holstein, schedule integrator for Dreamliner Operations.

Among the Boeing leaders who spoke was Jim Albaugh, president and CEO of Commercial Airplanes. "It's not often that we have the chance to make history, do something big and bold that will change the world in untold ways and endure long after we are gone."

Ito then spoke of "lovingly" taking the first 787 home to Japan. And he talked about the special bond between Boeing and ANA employees.

"I'll be on the delivery flight and will hold on tight to the dreams of everyone gathered here," Ito said.

Ingrid Stroeder, a supply chain analyst at the Everett Delivery Center, was touched by Ito's comments. "When he talked about teaming, you knew he meant it," she said. "I loved watching his whole face brighten as he was handed the key to the plane."

She was not alone with her feelings. Many were similarly moved by what they saw and heard during the ceremony.

"This delivery gave a boost to dreams of tomorrow," said Pearlie Welch, Quality records specialist for Boeing Test & Evaluation.

Joann Wells was representing the Boeing South Carolina team, which next year will be delivering 787 Dreamliners made there.

"There were tears of joy from people all around us," Wells said. "I could not help but cry, too. It was just fantastic."

Scott Gaskin, lead Manufacturing Engineer, Everett Modification Center, described it as an "over-the-top, once-in-a-lifetime experience. I could feel the excitement in the air."

Justin Hale, former 787 deputy chief

mechanic, said he thought of "all the people who had provided the genius to make the 787 a truly unrivaled airplane."

"It was impossible to ignore the beauty, quality and ingenuity of the Dreamliner," Hale said.

In closing the ceremony, Scott Fancher, vice president and general manager of the 787 program, said to the team: "You have succeeded in delivering an amazing airplane. You did it while respecting the needs of our customers and the traveling public. And you did it by never compromising on doing the right thing."


Ian Nash, 787 Final Assembly and Delivery team, may have best summed it up by saying, "Now we all get the honor of delivering 800-plus more Dreamliners." ■

[loretta.m.gunter@boeing.com](mailto:loretta.m.gunter@boeing.com)

***"Embodied in this incredible machine are 95 years of Boeing aerospace know-how."***

*— Jim McNerney, Boeing chairman, president and CEO*



A group of Boeing employees, including men and women of various ethnicities, are standing in a line on a factory floor. They are looking towards a large, dark, curved aircraft component, likely a wing or tail section, which is suspended from the ceiling. The background is a bright blue wall with a grid pattern. The lighting is bright, casting long shadows on the floor.

***“It was impossible to ignore the beauty, quality and ingenuity of the Dreamliner.”***

*— Justin Hale, former 787 deputy chief mechanic*



***“ANA showed Boeing a great deal of respect by being patient through our challenges. We honored that by bowing at the ceremony.”***

*– Ted Holstein, schedule integrator for Dreamlifter Operations*

***“It’s not often that we have the chance to make history, do something big and bold that will change the world in untold ways and endure long after we are gone.”***

*– Jim Albaugh, president and CEO, Commercial Airplanes*



***“I cannot wait to see the day when the  
skies of the world are filled with 787s.”***

*– ANA President and CEO Shinichiro Ito*



# 'As great as ever'



**"It was a great airplane back then, and it's a fabulous airplane now."**

— Ruby Caballero, team lead, 747 Interiors

## The 747-8 extends an incredible aviation legacy

By Joanna Pickup

**W**ith a small computer balanced on his lap, Chuck Newcombe sat in the cockpit of a new 747-8 Freighter preparing to load customer-specific software into its onboard computer.

The aviation maintenance technician fired off one of the one-liners for which his co-workers have dubbed him "Jokes," and then settled in for the serious task of transferring Electronic Flight Bag software into the airplane's computer. The flight bag's electronic files of airline routes and maps is just one of the many new features of the 747-8 that Newcombe and his teammates have to install and test before getting the aircraft completed, ticketed and ready to deliver to customers.

It was lots of work, he said dryly. And not just for him.

"We've all worked really hard to get to first delivery of this incredible airplane," said the 23-year Boeing veteran, using an adjective to describe the 747-8 that has a familiar ring.

The Boeing teams that designed, developed and built the original 747 more than four decades ago are often called the "Incredibles" for the tremendous job they did. And the airplane that extends their legacy is itself, as Newcombe aptly described it, incredible.

More than 18 feet (5.6 meters) longer than the 747-400, the 250-foot-long (76-meter) 747-8 Freighter is the largest

commercial airplane Boeing has built and has significant improvements in payload and range, as well as lower emissions and noise reduction. It represents more than six years of hard work.

Boasting a maximum takeoff weight of almost a million pounds (454,000 kilograms) and more than 30,000 cubic feet (800 square meters) of cargo space, the 747-8 Freighter will allow airlines to ship more cargo than ever before to cities as far apart as Los Angeles and Melbourne, Australia. The additional cargo capacity provided by the 747-8 Freighter is essential to operators as they plan for long-term air cargo traffic growth.

Few understand the incredible journey of the 747 better than John Sudds and Ruby Caballero.

As one of the original 747 employees—the Incredibles—Sudds has seen a lot of change since his first day on the job in 1967. Now a principal technical designer, Sudds' first designs were hand-drawn with pencils on drafting tables. Measurements were taken with a wood ruler. He remembered getting stuck in a traffic jam on the

**PHOTOS: (Right)** The nose of a 747-8 Freighter. **BOB FERGUSON/BOEING** **(Insets, from left)** Rudy Caballero, team lead, 747 Interiors. **BOB FERGUSON/BOEING** The front of the 747-8 Freighter opens for cargo loading. **BOEING** Engines on the 747-8 are quieter and efficient. **BOB FERGUSON/BOEING**





two-lane road that once was the only route to the factory in Everett, Wash. It's now one of the state's leading tourist destinations and its biggest factory, served by a multilane freeway and dedicated highway interchanges.

"Everything has evolved," he said.

Sudds has been designing floorboards for 40 years. Looking at his computer screen filled with images of engineering drawings, he recalled being a part of the team that designed the first computerized structural drawings of the 747 and helped automate processes.

"It's exciting to watch how the product line, and the way we do our jobs, continues to change over time," Sudds added. "The plane is as great as ever."

Caballero, who has also spent the past

several decades on the program, agreed.

"I've seen a lot over the years," Caballero said. "I started as a mechanic installing all of the interiors, sidewalls, stow bins, you name it. Now everything is modernized and upgraded."

Although she still works on the same part of the 747—its interiors—she said there are always new challenges that must be met.

Caballero still has a 1970's issue of *National Geographic* where she was featured building the interior of 747. "Where does the time go?" she said, laughing at how young she looks in the magazine photo.

She paused and looked at the 747-8 Freighter behind her, "It was a great airplane back then, and it's

a fabulous airplane now," she said.

Or as Sudds put it, "The 747-8 is the airplane." ■

[joanna.pickup@boeing.com](mailto:joanna.pickup@boeing.com)

**PHOTOS: (Below)** A 747-8 Freighter takes off from Paine Field in Everett, Wash. **BOEING** (Insets, from left) John Sudds, 747-8 principal technical designer. **BOB FERGUSON/BOEING** A 747-8 in final assembly. **BOEING** The 747-8 is readied for first delivery. **BOB FERGUSON/BOEING**



**"It's exciting to watch how the product line, and the way we do our jobs, continues to change over time."**

— John Sudds, principal technical designer, 747-8 Program



# Second nature

Boeing cleans up old site pollution with help from the environment

By Patrick Summers

Michael Spain can look out over a grove of cottonwood trees and acres of clover and alfalfa to a small windmill that sits inside the sustainable remediation area at the Emery Landfill in Wichita, Kan.

"A lot of the technology we use for cleaning up the landfill comes from nature," said Spain, a Boeing remediation project manager. "Some of our ideas, especially for generating power, have been around for more than 100 years."

Wind, sunshine and native vegetation all play an important role in powering and sustaining the cleanup of the 69-acre (28-hectare) site along the Arkansas River. The clean, renewable energy generated by the windmill and a small solar-powered water pump also significantly reduce the site's operating and maintenance costs.

The Emery Landfill is part of Engineering, Operations & Technology's remediation program, which cleans up locations affected by past business operations.

"Sustainable means minimizing the environmental footprint of cleanup activity, with an emphasis on employing renewable energy, protecting water supplies and restoring natural ecosystems," said Wayne Schlappi,

a Boeing remediation project manager.

Boeing began using the landfill for industrial waste from the Wichita site in the mid-1950s. Boeing Wichita produced nearly 15,000 aircraft, including B-52s and B-29s, as well as fuselages, tail sections and components for commercial airplanes.

The company purchased the Emery Landfill site in 1983. When low levels of contamination including volatile organic compounds were detected in the groundwater in 1987, the company developed a remediation plan and began site cleanup in 1991. Although the landfill closed in 2007, remediation activity continues.

The first remediation plan used a "pump and treat" system to pump out and treat contaminated groundwater with air strippers, an energy-intensive technology that blows air through the water to separate out the volatile organic compounds. It required 27 water pumps.

"With the pump-and-treat system, you basically will be pumping water forever," Spain noted, since the system does not stop ground- or rainwater from infiltrating the landfill, becoming contaminated and flowing off-site.

In 2009, the remediation team designed a "closed cell" sustainable system for the landfill that stops groundwater and most rainwater from entering the site and contamination from leaching off-site. The system pumps out the small amount of rainwater that still seeps into the landfill.

The sustainable remediation technology includes:

- A 30-inch-thick (76-centimeter) clay barrier that extends from ground level to bedrock 30 feet (9 meters) below the surface and encapsulates the site
  - A 30-inch-thick clay cap that covers the top of the landfill
  - A layer of native grasses and alfalfa atop the clay cap, with roots that can extend down 30 feet and help absorb water
  - One windmill-powered and one solar-powered water well; each pumps three to four gallons (11 to 15 liters) per minute
  - Twenty-one mature cottonwood trees that each can absorb an estimated 500 gallons (1,900 liters) of water per day, naturally assisting the mechanical pumps in removing contaminated water
- An added advantage of the closed cell, Spain said, is a lack of oxygen that creates

perfect conditions for the growth of natural bacteria that eat volatile organic compounds. Water pumped from the site meets health standards that allow it to be discharged untreated into the local sewer system.

The two renewable energy-powered water pumps and one remaining electric pump replaced the 27 water wells needed for the previous cleanup system. The sustainable remediation strategy's operational efficiencies have the benefit of reducing energy use, carbon footprint and costs, Spain noted. The site's monthly electric bill for remediation has been cut from \$900 to about \$30, and the annual cost of water sampling has dropped from \$80,000 to \$5,000.

The project is an excellent example, Spain said, of how the Sustainable Remediation Program is achieving a "triple bottom line"—environmental, economic, and social goals and objectives. ■

[patrick.a.summers@boeing.com](mailto:patrick.a.summers@boeing.com)

**PHOTO:** Remediation project manager Michael Spain inspects the Emery Landfill area in Wichita, Kan., surrounded by fields of alfalfa and clover. BEVERLY NOWAK/BOEING

## Korea at a glance

**Official name:** Republic of Korea

**Location:** On the Korean Peninsula between the Yellow Sea to the west and the East Sea to the east; only bordering nation is the Democratic People's Republic of Korea (North Korea)

**Area:** 38,500 square miles (100,000 square kilometers), slightly larger than the U.S. state of Indiana

**Population:** More than 48.7 million, ranks 26th highest in the world

**Official language:** Korean

**Capital:** Seoul

**Other key cities:** Busan, Incheon, Daegu and Daejeon

**Gross domestic product, 2010 estimate:** \$1.47 trillion (U.S. dollars), ranks 13th worldwide

**GDP growth rate, 2010 estimate:** 6.1 percent

**Largest export partners:** China, United States, Japan and Hong Kong

**Direct Boeing employees in Korea:** 190

*Sources: The World Factbook, U.S. Department of State, Boeing*

# ROKstar

## South Korea is one of Boeing's top markets for both defense and commercial products

**By Eric Fetters-Walp**

The Republic of Korea has emerged as a vibrant economic force and one of the world's most technologically advanced nations in the 21st century.

Korea isn't large geographically—it would rank 38th among the 50 U.S. states—but its gross domestic product annually ranks in the top 15 internationally.

That's a great achievement for a nation that suffered more than its share of war and political turmoil during the past century. But with a culture dating back at least 4,000 years, one of the world's highest population densities and a historically important location, it should be no surprise Korea has moved forward so fast.

"It is a large and growing economy. They've done an amazing transformation over

the past 30 years," said Shep Hill, president of Boeing International and senior vice president of Business Development and Strategy.

The nation's economic rebirth and its strategic position on the Korean Peninsula have made the Republic of Korea a major Boeing customer and supplier. It is a market with two important military aircraft competitions on the horizon, as well as a customer for three of Boeing's newest commercial airplane models.

"In recent years it has consistently been one of Boeing's top markets," said Patrick Gaines, president of Boeing Korea. "Korea is an ideal 'One Boeing' market with our revenues being split almost equally between Boeing Defense, Space & Security and Commercial Airplanes. Our work in-country often complements

sales in both business units."

During its 60-year military partnership with the United States, the nation has often turned to Boeing and its heritage companies to help equip its defense forces, starting with Douglas Skyraiders during the Korean War. Since then, Boeing has delivered 30 CH-47D and HH-47D Chinook heavy-lift and air rescue helicopters to the Republic of Korea Army and Air Force, making Korea the third-largest operator of Chinooks outside the United States.

In 2002, Boeing won a multibillion-dollar contract over three competitors to provide Korea with 40 F-15K Slam Eagle jet fighters. That was followed in 2008 with another multibillion-dollar contract to produce 21 additional F-15K jet fighters, with deliveries continuing through next year.

"It's a very important market. Our

products here are the backbone of the ROK Air Force, and Korea represents one of the largest international markets for us," said Chris Chadwick, president, Boeing Military Aircraft.

In the coming months, Korea is likely to request bids for its third jet-fighter acquisition program since the early 2000s—FX-III. Boeing will offer the F-15 Silent Eagle, a newly developed, stealthier version of the F-15 the ROK Air Force already operates. Eunjeong Bahn, the F-15K program's logistics support representative in Korea, said the next-generation Silent Eagle would be well-suited for the operational environment in and around Korea.

At present, Boeing is focused on helping deliver the remainder of its existing F-15K orders and providing support for the Republic of Korea's Air Force fighter

**"Korea is an ideal 'One Boeing' market."**

— Patrick Gaines, president of Boeing Korea

**PHOTO:** An F-15K Slam Eagle jet fighter on the runway at Daegu Airbase, Korea. Over the past decade, the Republic of Korea has ordered more than 60 of the Boeing-built fighters. REPUBLIC OF KOREA AIR FORCE

fleet. Bahn said the complex F-15K fighters have an impressive operational readiness rate of 85 percent, which supports Boeing's future bid. "A happy customer often is a return customer," she said.

Korea's government also is considering the acquisition of up to 36 AH-64D Apache attack helicopters. Additionally, Boeing Defense, Space & Security is working with the ROK Air Force and ROK Army on upgrading their Chinook helicopters.

To meet its military surveillance needs, Korea has ordered four Peace Eye aircraft, a 737-based Airborne Early Warning & Control aircraft similar to Australia's Wedgetail and Turkey's Peace Eagle models. The first Peace Eye recently was delivered to the ROK Air Force, while the next three are being modified by Korea Aerospace Industries in Sacheon between now and late 2012.

Troy Hall, senior manager and on-site team lead for the Peace Eye program, said the KAI team's accomplishments show

why the company was honored as a 2010 Boeing Supplier of the Year.

"I'm impressed with the quality of the workmanship and the team's dedication," Hall said. "We are getting it done right and on schedule."

On the commercial side, Korea's airlines are growing in response to passenger demand. The nation's airlines saw a record number of international passengers fly during May of this year, according to the Ministry of Land, Transport and Maritime Affairs.

During the next 20 years, air travel in Asia is expected to grow at an annual rate of 6.7 percent. This rapid growth suggests that Korea will need more than 500 new airplanes to meet demand, according to Boeing forecasts. With Incheon International Airport serving as a major hub in Asia, Korea's commercial airline business is well-positioned to benefit from future growth in the region's air travel.

"Korea was not as hard hit by the global economic downturn," Gaines noted. "Both the major carriers and the low-cost carriers have been

very profitable and need airplanes to keep up with the growth requirements."

Korea's flag carrier, Korean Air, recently took delivery of its first Next-Generation 737-900ER (Extended Range) featuring the Boeing Sky Interior. It is among the first customers to purchase the 747-8 Freighter, the 747-8 Intercontinental and the 787 Dreamliner. Korean carriers also hope to gain momentum from Pyeongchang's successful bid to host the 2018 Winter Olympic Games.

Gaines sees more work with Korean suppliers as Boeing defense and commercial programs advance. He also forecasts growth opportunities for Boeing's services in Korea. Boeing Training Services-Korea, part of Boeing Flight Services, already provides flight training for Boeing and Airbus aircraft at the training facilities of the two largest airlines in Korea: Korean Air and Asiana.

"Being embedded with the customer at their facility creates an invaluable understanding of the customer's training needs," said Soo-Mi Hong, business support manager for Boeing Training Services-Korea. The business, she added, also serves Jin Air; the Ministry of Land, Transportation and Maritime; and other smaller customers.

With the shared security and economic interests between Korea and the United States, Boeing actively has supported technology exchanges in defense products and advocated the United States-Korea Free Trade Agreement, Hill said. The agreement is awaiting approval from both nations' legislatures.

"As Korea's aspirations grow, we can't take anything for granted," Hill said. "We need to keep our focus on our customers there."

Kyung Yeon Kang, executive office administrator for Boeing International in Seoul, said it's gratifying to see the company invest in both the country's manufacturing base and, through Global Corporate Citizenship programs, its communities.

"I am proud to be able to say that the company I work for contributes to the Korean economy and the Korean aerospace industry," Kang said. ■

[eric.c.fetters-walp@boeing.com](mailto:eric.c.fetters-walp@boeing.com)

# Value chain

## Boeing has built strong relationships with its South Korean suppliers

Korean Air ordered its first commercial jetliner—a Boeing 707—in 1969 and launched Korea's first aerospace manufacturing company seven years later. Now, the nation is a trusted supplier for myriad Boeing products.

"Boeing is in Korea, but Korea also is involved with Boeing," said Patrick Gaines, president of Boeing Korea. "Every time you see a commercial airplane fly by, or an F-15 or an Apache, you're seeing components made here."

Korean Air Aerospace Division was the first aerospace firm established in Korea. It has since partnered with Boeing to provide components for the 717, 747, 777 and the 787 Dreamliner. Its high-quality work earned it the title of Boeing Supplier of the Year in 2000 and 2006.

Korea Aerospace Industries formed in October 1999 when Daewoo Heavy Industries, Samsung Aerospace, and Hyundai Space and Aircraft combined into one enterprise. The company has become a prime supplier of 737 horizontal and vertical assemblies; it soon will begin work on 787-9 composite wing ribs for Commercial Airplanes.

For Boeing Defense, Space & Security, KAI manufactures AH-64 Apache helicopter fuselages and F-15 forward fuselages and wings. KAI also is a key supplier on the A-10 Wing Replacement Program.

Additionally, KAI is making the extensive modifications necessary for the 737-based Peace Eye Airborne Early Warning & Control aircraft. The company's high-quality,

on-time deliveries earned it a 2010 Boeing Supplier of the Year award.

Boeing also owns part of Korea-based Huneed Technologies to subcontract work in Korea's command, control, communications and networks market.

"Many of Boeing's supplier relationships in Korea began as part of our offset, or local work placement, programs," Gaines said. "And when you look at the quality and value we have achieved, it's clear these relationships have grown into great supplier partnerships."

— Eric Fetters-Walp



**PHOTOS: (Far left)** An employee of Korea Aerospace Industries in Sacheon, Korea, works on one of three Peace Eye Airborne Early Warning & Control aircraft being modified by the company. **(Above)** Korean Air Aerospace Division workers perform maintenance on the engine of a 747-400 Freighter. The company provides components for Boeing's 717, 747, 777 and the 787 Dreamliner.

# Sky-high opportunities

Boeing has more than 60 percent of the jetliner market in South Korea

Demand for air travel in Korea has increased rapidly in recent years, driving growth for the mix of low-cost domestic and regional airlines and large international carriers serving the nation.

Four of the five newest carriers that

serve the low-cost, regional market operate all-Boeing fleets. These airlines operate alongside the nation's two long-established, larger international carriers, Korean Air and Asiana. Korean Air is among the first airlines to purchase three of Boeing's newest commercial models—the 787 Dreamliner, the 747-8 Freighter and the 747-8 Intercontinental.

Both Korean Air and Asiana also have ordered a notable number of 777-200ER (Extended Range) and -300ER models in recent years—with the former having taken delivery of its 30th 777 in May. On the cargo side, Korean Air ranked second worldwide last year in scheduled freight tonne kilometers, according to the International Air Transport Association.

"Our estimates are that Korea will need more than 500 new airplanes by 2030, so it's a big market and one that's growing," said Fariba Alamdari, vice president of Market and Value Analysis for Commercial Airplanes. She added



**"Our estimates are that Korea will need more than 500 new airplanes by 2030, so it's a big market and one that's growing."**

— Fariba Alamdari, vice president of Market and Value Analysis for Commercial Airplanes

that Boeing holds a market share of more than 60 percent in commercial aviation in Korea, "so we have a good opportunity to be a big player there."

A quick look at Korea's major commercial airlines:

- **Korean Air** – Korea's original airline, Korean Air's fleet of 112 passenger airplanes includes 18 Boeing 747-400s, 18 777-200ERs, a dozen 777-300ERs and -300s, and 32 Next-Generation 737s; the remainder consists of Airbus models. The airline also owns and operates 24 747-400 Freighters for its cargo business.
- **Asiana Airlines** – One of the two largest airlines in Korea, Asiana operates two Boeing 737-400s, 767-300s (seven passenger and one cargo), 11 777-200ERs and 12 Boeing 747-400s, with a mix of passenger-only 747s, combination passenger/cargo 747s and cargo-only jets. It also operates 38 Airbus jets.
- **Jeju Air** – Launched in 2005 and based in Jeju City, this low-cost carrier flies an all-Boeing fleet of eight Next-Generation 737-800s. The airline flies within Korea and to destinations in Japan and East Asia.
- **Air Busan** – A low-cost subsidiary of Asiana, Air Busan flies several routes between Korea and nearby nations in Asia. Its fleet includes three 737-400s and three 737-500s.
- **Eastar Jet** – This low-cost carrier, which first flew in 2009, is an all-Boeing airline, flying six Next-Generation 737-600s and 737-700s on short-haul routes within Korea and to other nearby destinations.
- **Jin Air** – This subsidiary of Korean Air is a low-cost airline flying an all-Boeing fleet of five Next-Generation 737-800s between Korea, multiple destinations in East Asia and Guam.
- **T'way Airlines** – This low-cost carrier has a fleet consisting of three Next-Generation 737-800 airplanes. It flies only domestic routes.

— Eric Fetters-Walp

# Good partners

Boeing supports Korean communities through a wide range of investments

Teaching young people about the environment, supporting orphaned children and helping underprivileged youth learn more about business are just three programs assisted by Boeing's community partnerships in Korea.

Every year, in partnership with thousands of nonprofits and other organizations around the globe, Boeing invests in programs that target areas that help build and sustain strong communities: the environment; health and human services; arts and culture; and education and civic awareness.

Boeing Korea in 2010 made community investments in eight different organizations, and employees are active in their communities across Korea, including participation in Boeing's annual Global Day of Service.

The Korea Green Foundation, a grant recipient, leads a "Climate Change Classroom" program that teaches children, especially those from low-income families, about environmental issues.

"Throughout this program, these future environmental leaders will recognize the importance of eco-friendly management of businesses and the importance of building a sustainable future to set an example for generations to come," said Yul Choi, president of the Korea Green Foundation.

Other programs receiving community investments include Young Falcons of Korea, which teaches awareness of environmental issues in aerospace and other industries; the Pearl S. Buck Foundation Korea, focused on cultural understanding; Community Chest of



Seoul, which sponsors after-school counseling and activities in high-poverty areas; Haesung Orphanage, which provides therapy for orphans; Work Together Foundation, organizing arts programs at children's welfare centers; Junior Achievement Korea, which educated more than 10,000 underprivileged students last year in economics and business; and a science education program aimed at improving teachers' skills. Additionally, Boeing employee volunteers have prepared and served meals for homeless people in Seoul, helped disabled residents take a mountain excursion, played with orphaned or abandoned children, and taken on maintenance and cleanup activities at the Changdeokgung palace grounds in Seoul.

"Having the opportunity to give back to the community means a lot to me and my team," said Sang Mun, senior manager for Phantom Works International Experimentation-Korea. "I am proud that Boeing understands the importance

of corporate citizenship and encourages employees to participate."

— Eric Fetters-Walp

**PHOTO ILLUSTRATION: (Far left)** A 747-8 Intercontinental in Korean Air livery. Korean Air has seven 747-8 Freighters and five 747-8 Intercontinental airplanes on order. MI-KYOUNG CHOI/BOEING

**PHOTO: (Above)** Boeing Korea volunteers work on a project with tenants at the House of Love facility for the disabled in Namhae, Korea. ASSOCIATED PRESS

# How healthy are we?

Boeing's online Health Assessment helps employees identify risks

By Ken Groh

For some of the more than 118,000 Boeing employees and spouses or their eligible domestic partners who completed the annual online Health Assessment last year, their personal results produced a sigh of relief—it confirmed good health. Others, however, viewed their results as a yellow traffic light, signaling they needed to take actions or change their lifestyles to reduce a potential health risk.

A few found the Well Being Online Health Assessment to be a lifesaver: Their individual results called for immediate action.

#### What did employees do with their personal results?

Many employees shared their results with their doctors, while others spoke with lifestyle coaches. Some also used their health care plans' website tools and resources to learn more about their health. Such actions today help employees live a healthier tomorrow.

**What did Boeing do with the results?** Under the federal Health Insurance and Portability and Accountability Act, Boeing cannot access individual results. However, the company does receive summary reports containing aggregated data, without any individual identification, to compare with national averages and to use in designing health-related resources for employees and their families.

The chart shows several key indicators from the summary reports that are often linked to preventable health risks. Employees can compare individual results to the summary and see how they measure up. For example, 79 percent of Boeing employees who completed a health risk assessment are not following nutritional guidelines on a regular basis. Some may be at risk later in life for health conditions related to poor eating habits. In this example, Boeing uses the summary results to create the right programs for helping those who want to take action for better nutrition.

This year's online Health Assessment is available from late October to Dec. 23. Employees can enter their health numbers obtained from on-site screenings or their most recent health checkup. Those nonunion employees enrolled in a Boeing health care plan who choose to complete the online Health Assessment before the deadline will avoid paying an additional contribution for their medical plans in 2012. The goal is for employees and their enrolled spouses or eligible domestic partners to know their results, be aware of any health risks, and seek appropriate medical care if their Health Assessments signal they need treatment.

#### Why is it important to complete the Health Assessment every year?

At Boeing, the health of employees and their families is a strongly held value. The few minutes employees spend completing the online Health Assessment can translate to days and even years of more enjoyable time with the people who matter most. ■

*kenneth.f.groh@boeing.com*

#### Key indicators of healthy behaviors

Boeing results from last year's Health Assessments show four indicators that are often linked to preventable health risks.



#### Protecting personal health information

Employees who complete on-site screenings or annual physicals with their doctors have the results they need to complete the online Health Assessment. Individual results from the on-site screening and online Health Assessment are not shared with Boeing. The company does have access to aggregated information about health issues faced by all health care plan participants, and that data helps determine the specific tools, resources and programs employees need to make good health decisions.

#### New this year

When employees go online to complete the Health Assessment this year, they will use a University of Michigan questionnaire. The university has been at the forefront in developing the process for health assessments since 1978 and is one of the nation's leading research facilities studying the value of healthy lifestyles.

Boeing's health management supplier, OptumHealth, is a partner with the University of Michigan in identifying health risks and offering assistance to those who wish to improve their health. In all cases, both the University of Michigan and OptumHealth use the utmost security in handling health information and are bound by law to protect it.

# Above and beyond

Started by Howard Hughes, Boeing's satellite-making plant in El Segundo has been an industry leader for 50 years

By Mike Lombardi and Diana Eastman

One of the great legacies of The Boeing Company is the development of the commercial jet, which has made it possible to bring people together from around the world in a matter of hours.

Satellites, too, have brought people closer—at the speed of light.

And that's another significant Boeing legacy, albeit one that may not be as well-known as the company's contributions to the jet age.

But over the past five decades, Boeing Space & Intelligence Systems, which includes the former Hughes Space and Communications Co., Rockwell International and McDonnell Douglas, has been a major force in the satellite market, pioneering technologies that people around the world use every day, from communication and entertainment

to navigation and weather monitoring.

Boeing's legacy of satellite development began 50 years ago, with aviation icon and billionaire Howard Hughes.

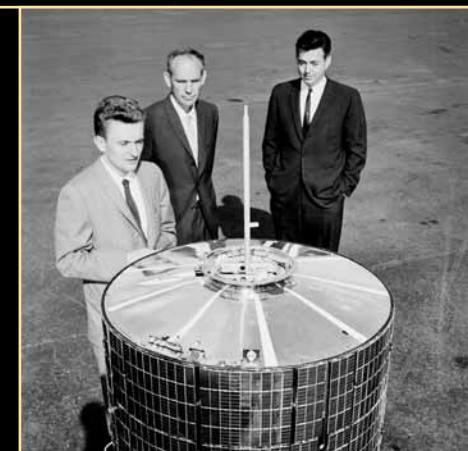
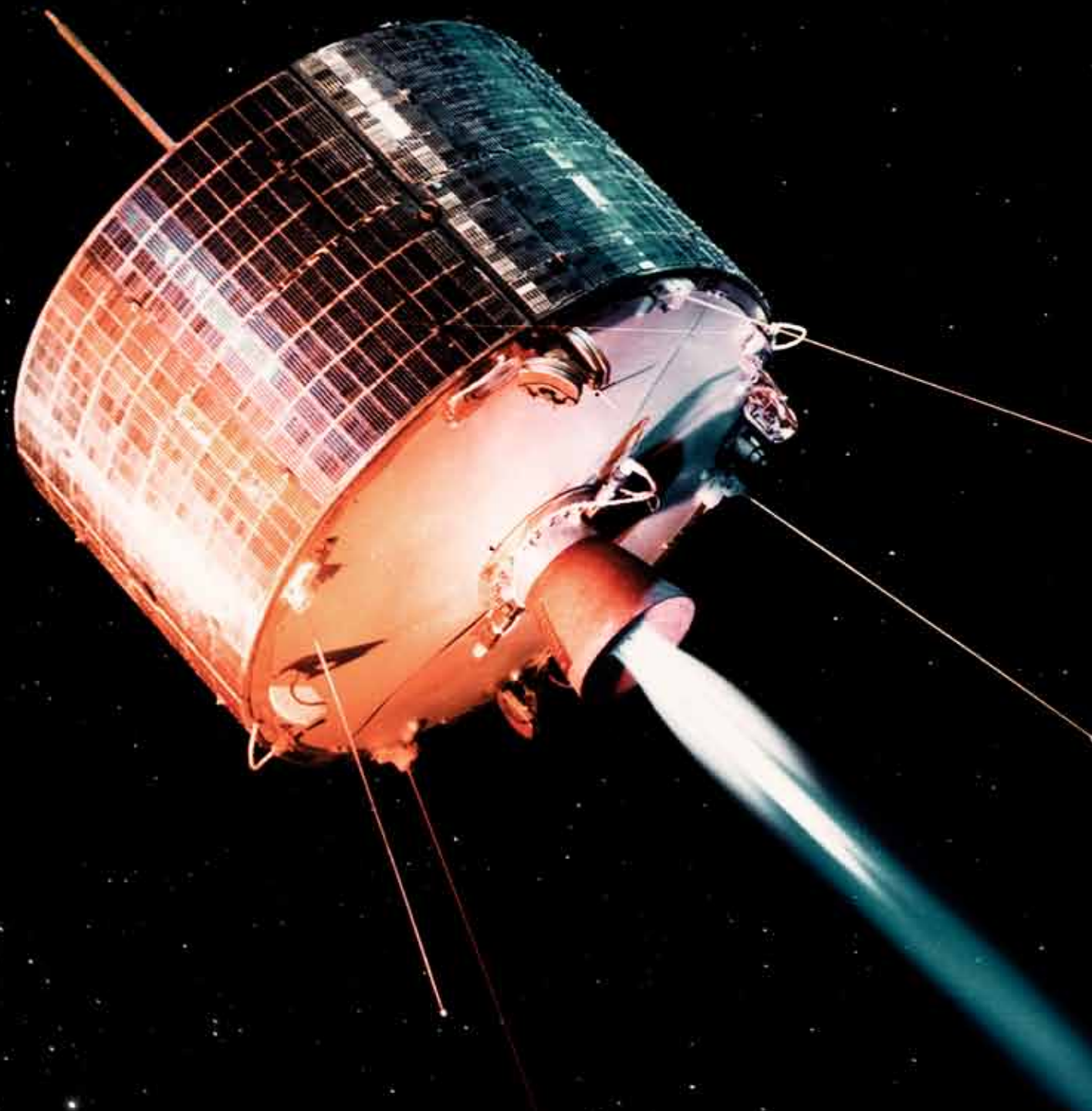
In 1961, Hughes formed the Hughes Space and Communications Co. as part of Hughes Aircraft. The new company set up operations in El Segundo, Calif., at a plant that was formerly operated by American Motors.

First opened in 1948 as the El Segundo Plant for Nash Motors, the 500,000-square-foot (46,500-square-meter) facility had been purchased by the reclusive Hughes in 1955 for \$3 million. Once the birthplace of the Nash Rambler, today it is the Boeing Satellite Development Center and, with more than a million square feet (93,000 square meters), it is the world's largest satellite factory.

Although the former Soviet Union

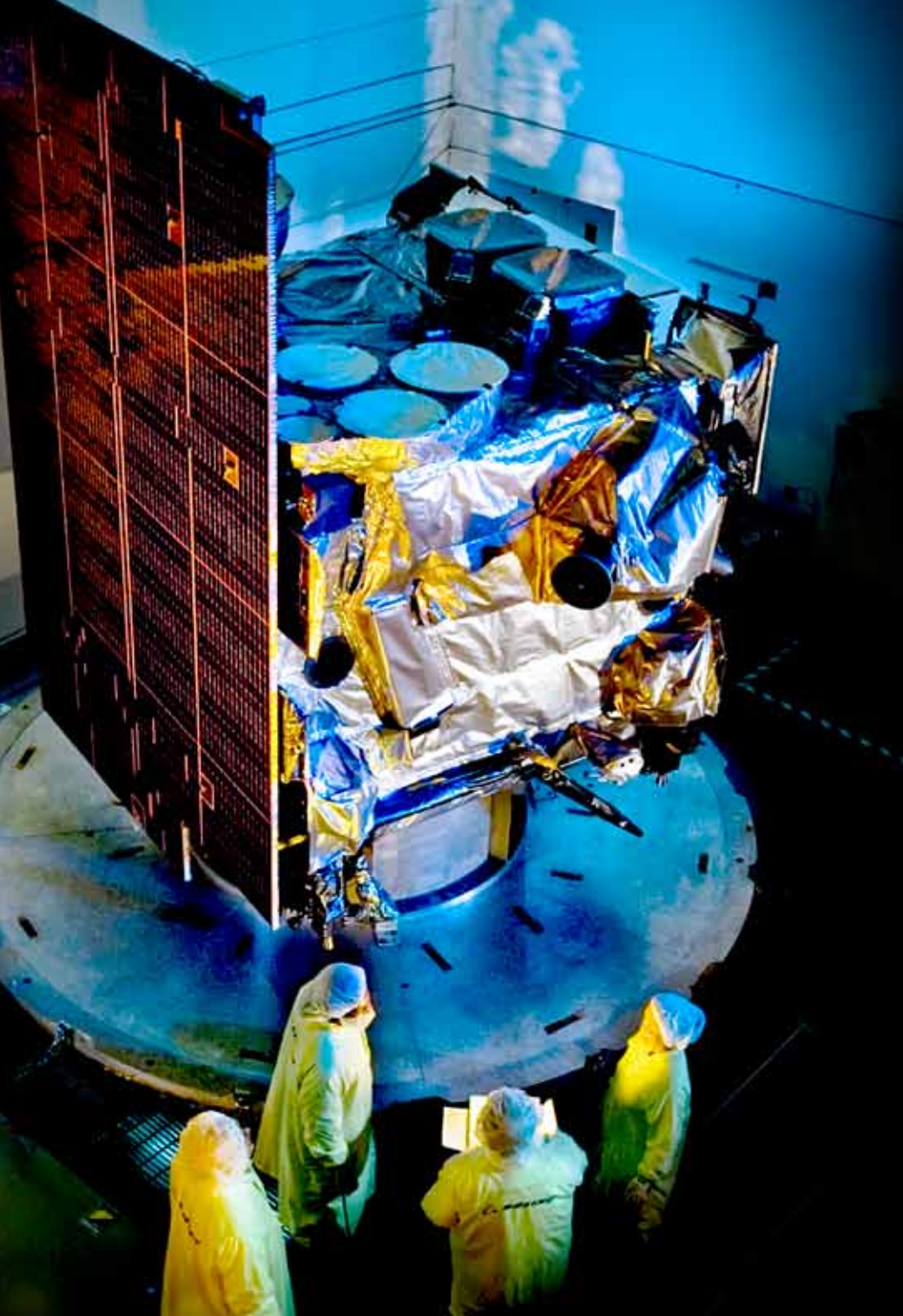
launched the first satellite, Sputnik, into orbit, on Oct. 4, 1957, Hughes Space and Communications launched the satellite industry with the first geosynchronous communications satellite, Syncom, in 1963. The company followed with the launch of Early Bird, the first commercial communications satellite. Another milestone came in 1966 with the Application Technology Satellite ATS-1, the first geosynchronous satellite capable of meteorological observations.

Hughes Space and Communications did not limit itself to satellites that orbited Earth; it also took a leading role in exploring the solar system, starting in 1966 when Surveyor 1 made the first fully controlled soft landing on the moon. It paved the way for U.S. astronauts landing on the moon three years later. In 1978, Pioneer Venus



**PHOTO ILLUSTRATION: (Above)** Syncom, the first geosynchronous communications satellite, was built by Hughes Space and Communications. NASA

**PHOTOS: (From far left)** The Nash/American Motors sign comes down at the El Segundo, Calif., plant in 1961 to make way for satellite-maker Hughes Space and Communications; satellite pioneers Don Williams (from left), Thomas Hudspeth and Harold Rosen are shown with the Syncom satellite; inside the El Segundo plant in the early days; Apollo 12 astronaut Charles Conrad Jr. inspects the Surveyor 3 satellite, which helped survey moon landing locations; and employees construct the Pioneer Venus satellite, which performed the first extensive radar-mapping of Venus. BOEING ARCHIVES



performed the first extensive radar mapping of the cloud-enshrouded planet, and in the 1990s Hughes' Galileo probe became the first spacecraft to penetrate Jupiter's atmosphere.

Boeing acquired Hughes Space and Communications in October 2000. Today, there are more than two dozen satellites in production at the El Segundo plant, including the newly developed Boeing 702MP (Medium Power), an evolution of the 702 series that will launch in 2012.

Other programs include MEXSAT, a satellite communications system for the government of Mexico, and Inmarsat-5, a series of satellites for global mobile communications. In addition to commercial satellites, Boeing makes a range of satellites for the military, including Global Positioning System satellites that provide worldwide navigation.

It's been an amazing record of achievement. Since Hughes Space and Communications set up operations in El Segundo in 1961, nearly 300 satellites built there have been launched into space on various commercial and military missions. They have transformed the world, and how billions of people live, work and communicate. They have helped blaze the way in the exploration of space—and understanding Earth itself.

Howard Hughes once said that he wanted to be remembered for only one thing—his contribution to aviation. Boeing's El Segundo satellite-making business is a testament to that legacy. ■

*michael.j.lombardi@boeing.com  
diana.b.eastman@boeing.com*



**PHOTOS: (Above)** GOES-15 was built by Boeing Space & Intelligence Systems. It's part of the fleet of Geostationary Operational Environmental Satellites that provide enhanced Earth observation and weather monitoring to NASA and the National Oceanic and Atmospheric Administration. **BOEING (Insets, from left)** The GPS IIF is the newest addition to a constellation of satellites built for the U.S. Air Force that a billion people rely on for precise timing and navigation; and the Boeing 702HP (High Power), the world's most powerful communications satellite, first launched in 1999. **BOEING**



**BOEING'S YELLOW SUBMARINE**

The whale-shaped, 18-foot-long (5.6-meter) underwater drone Echo Ranger recently made its first autonomous dives off Catalina Island, Calif., surveying an area beneath the Pacific Ocean while sending telemetry to Boeing engineers in surface boats. Although Echo Ranger was developed to capture high-resolution images of seabeds for the oil and gas industry, Boeing is now showcasing its capabilities for underwater intelligence, surveillance and reconnaissance missions and patrol of harbors and waterways for security threats. Echo Ranger is capable of diving to 10,000 feet (3,000 meters). Rockwell International, a Boeing heritage company, pioneered deep-dive manned submersibles in the 1960s. PHOTO: RANDY JACKSON/BOEING



