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IQ INNOVATION QUARTERLY

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Welcome Aboard

Inside the evolution of the passenger experience

PLUS: License to Drive the MQ-25
Moving the first-of-its-kind aircraft aboard an active carrier is a joy (stick)

CABIN COLLABORATION
(From left) Cabin team members Zach Kilcer, Katie Faires and Brenna Wynhof showcase a 787 Dreamliner cabin at the Boeing Customer Experience Center in Renton, Washington.

BOEING

Have a seat

HOW AIRPLANE INTERIORS EVOLVED TO MAXIMIZE SAFETY AND COMFORT

BY LESLIE HAZZARD, BOEING HISTORICAL SERVICES

The magic and safety of flight for passengers have improved exponentially throughout the past century.

PHOTOS COURTESY OF THE BOEING ARCHIVES UNLESS OTHERWISE NOTED

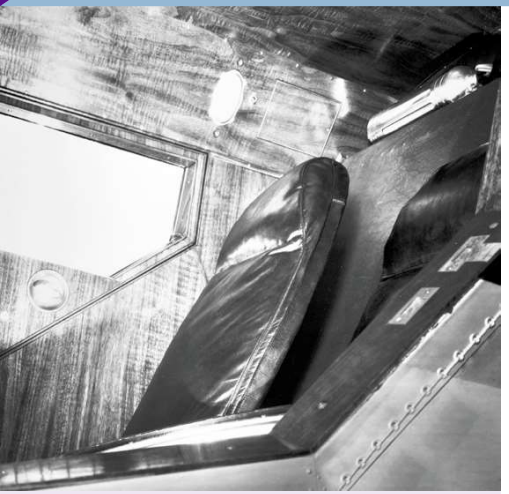
The Boeing Model 40A, which first flew on May 20, 1927, was the first Boeing airplane to carry airline passengers. Originally designed to carry mail, the plane had room for two passengers in a tiny cabin.

Just a year later, Boeing introduced America's first airliner designed specifically for passenger safety, comfort and convenience. The Model 80 carried 12 passengers in a spacious cabin appointed with leather upholstery, reading lamps, forced-air ventilation, and hot and cold running water.

Ellen Church, a registered nurse, convinced Boeing managers that women could work as stewards, so nurses serving aboard the Model 80A became aviation's first female flight attendants, helping to comfort passengers who felt ill and enhancing the safety of all onboard. The nurses earned $125 for flying 100 hours a month.

Boeing led the way in the development of modern all-metal, semi-monocoque, cantilever monoplanes, beginning with the Monomail. Originally a mail plane and later a six-passenger transport, the Monomail was a pioneer of all-metal design, which is more durable and resistant to damage and corrosion. All-metal construction quickly surpassed wood structures.

1920s



BOEING MODEL 40A

1930s

BOEING MODEL 80

FOKKER F-10
Boeing heritage company Fokker Aircraft Corporation of America was an early adopter of seat belts. Note the seat on the center right.

In 1933, Boeing delivered the revolutionary Model 247. It was an all-metal, twin-engine airplane and the first modern passenger airliner, ushering in the age of speed, reliability, safety and comfort in air travel. The Model 247 flew at 189 mph (304 kph), making its trip between New York and Los Angeles 7.5 hours shorter than earlier airplanes' trips, dramatically improving the experience for passengers.

The DC-1 (Douglas Commercial Model One), also introduced in 1933, was designed to compete against the Model 247. The DC-1 was advanced for its day, and its plush seats, kitchen and restroom set a new standard for passenger comfort. Great efforts were made to insulate the passenger compartment from the noise of the plane's engines. Passenger seats were mounted on rubber supports, while the cabin was lined with noise-absorbing fabric. Carpet covered the cabin floor, and even the engines were mounted on rubber insulators.

Inspired by the technical success of the Douglas DC-1, Douglas introduced the DC-2 less than a year after the DC-1's first flight. The new plane was similar in shape to the DC-1 but had more powerful engines, was faster and was capable of longer flights. The DC-2 was an instant hit, establishing 19 American speed and distance records in its first six months of service.

In 1934, Transcontinental & Western Air (TWA) put DC-2s on overnight flights from New York to Los Angeles. The airplanes, called "Sky Chiefs," left New York at 4 p.m. and, after stops in Chicago; Kansas City, Missouri; and Albuquerque, New Mexico, arrived in Los Angeles at 7 a.m. For the first time, passengers could fly from coast to coast without losing a business day.

The Douglas DC-3, which made air travel popular and airline profits possible, is universally recognized as the greatest airplane of its time. The first DC-3 built was the Douglas Sleeper Transport also known as the Skysleeper by airline customers — and it was the height of luxury. Fourteen plush seats in four main compartments could be folded in pairs to form seven berths, while seven more folded down from the cabin ceiling. The plane could accommodate 14 overnight passengers or 28 for shorter daytime flights.

1930s

BOEING MODEL 247

DOUGLAS DC-2

DOUGLAS DC-3 SKYSLEEPER

BOEING MODEL
307 STRATOLINER

The next major advancement in the passenger experience came with more powerful airplanes that could fly at higher altitudes. The Boeing Model 307 Stratoliner was the world's first high-altitude commercial transport and the first four-engine airliner in scheduled domestic service.

Its pressurized cabin allowed the airplane to safely soar above rough weather at an altitude of 20,000 feet (6,096 meters) — higher than any other transport of its time. And a circular fuselage provided maximum space for the five crew members and 33 passengers. The nearly 12-foot-wide (3.7-meter-wide) cabin had space for comfortable berths.

As airplane travel became popular during the mid-1930s, passengers wanted to fly across the ocean, so Pan American Airways (Pan Am) asked for a long-range, four-engine flying boat. In response, Boeing developed the Model 314, nicknamed the "Clipper" after the great oceangoing sailing ships.

Clipper passengers looked down at the sea from large windows and enjoyed the comforts of dressing rooms, a dining salon that could be turned into a lounge and a bridal suite. The Clipper's 74 seats converted into 40 bunks for overnight travelers. Four-star hotels catered gourmet meals served from the Clipper's galley.

1930s

BOEING MODEL
314 CLIPPER

DOUGLAS DC-6

The Douglas DC-6 was one of the first airplanes to offer passengers a regularly scheduled around-the-world route. The DC-6 could fly 90 mph (145 kph) faster than the DC-4 and 850 miles (1,368 kilometers) farther. It could also maintain a cabin pressure of 5,000 feet (1,524 meters) while flying at 20,000 feet (6,096 meters). Pan Am used the DC-6 to start tourist-class service across the North Atlantic.

After Boeing introduced the Model 367-80, or Dash 80 — the prototype for the world's first successful jet transport, the 707 — the rest of the company's 7-series jets soon followed. As the 707, 727 and 737 arrived in the 1950s and 1960s, all incorporated passenger improvements, including the ability to fly faster and at higher altitudes. For example, the 737 engines were mounted under the wing. This engine placement buffered some of the noise and decreased vibration.

1940s 1950s 1960s

BOEING 707

The 747 — the largest civilian airplane in the world at the time and the “Jumbo Jet” that made travel affordable for the masses — was built in roughly 16 months during the late 1960s.

Boeing connected the upper level of the 747 with the main cabin by a graceful spiral staircase that was based on a similar design from the Boeing 377 Stratocruiser. Starting with the 747, Boeing replaced hat racks in its commercial airplanes with overhead bins for increased convenience and safety. The bins kept baggage and other items secure during turbulence, preventing them from falling onto and injuring passengers.

HISTORY OVERHEAD

On the 747, overhead bins replaced the conventional hat rack-style storage, securing luggage in case of turbulence.

BOEING 747

Qantas Captain Cook interior

1960s

BEFORE

Early 727 interiors featured open storage above.

1970s

AFTER

Later 727 interiors featured overhead bins that closed for safety and convenience.

Decades later, in 2011, the last member of the 747 family — the 747-8 Intercontinental, serving the 400- to 500-seat market — made its first passenger flight. The cabin's sculpted ceilings, bigger overhead and side stow bins, a redesigned staircase and dynamic LED lighting all added to an enhanced passenger experience.

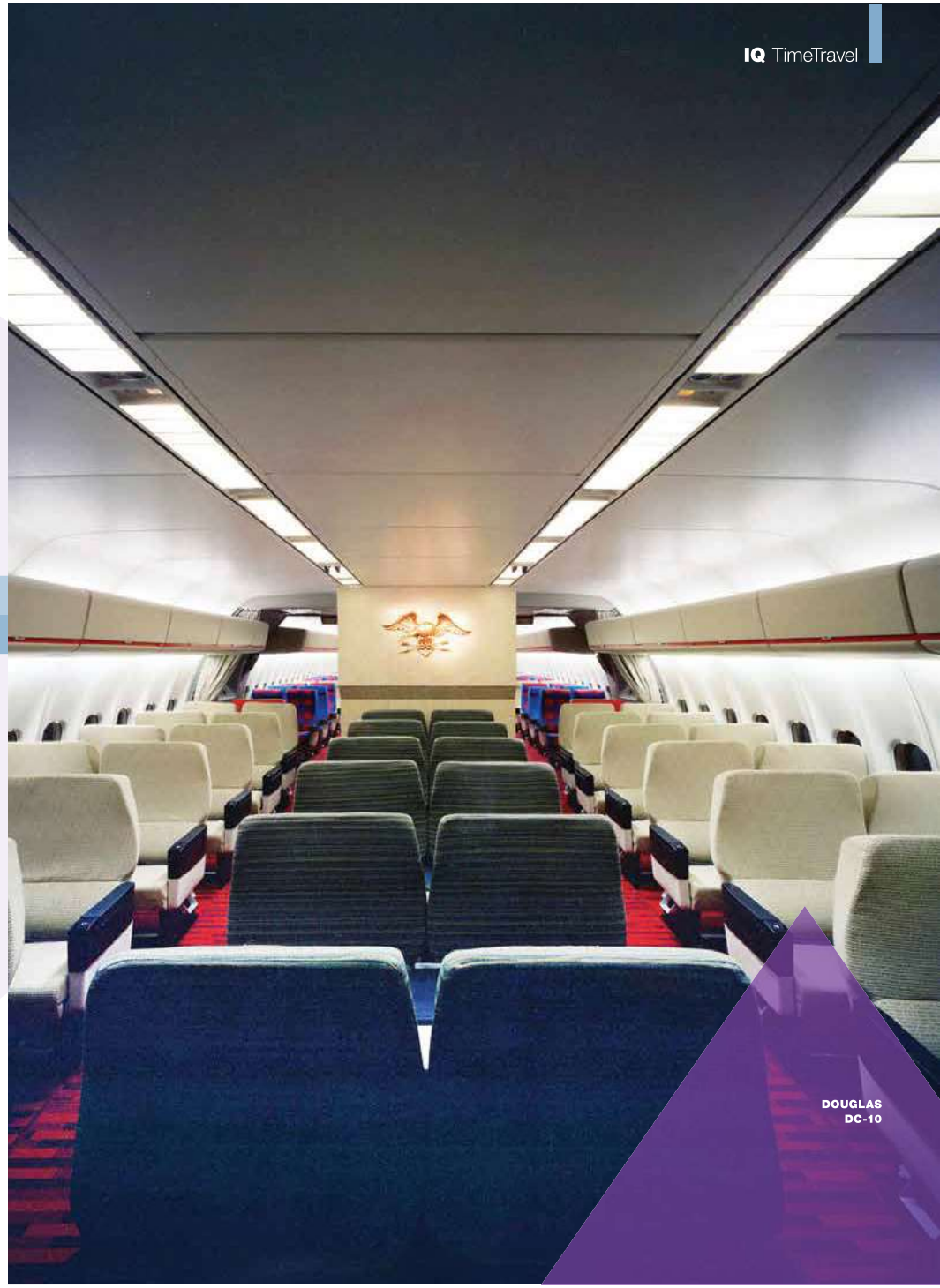
Both Boeing and Douglas (later McDonnell Douglas) went on to produce several more jetliners, including the 767, 777, DC-9, DC-10, MD-11, MD-80 and MD-90.

1980s

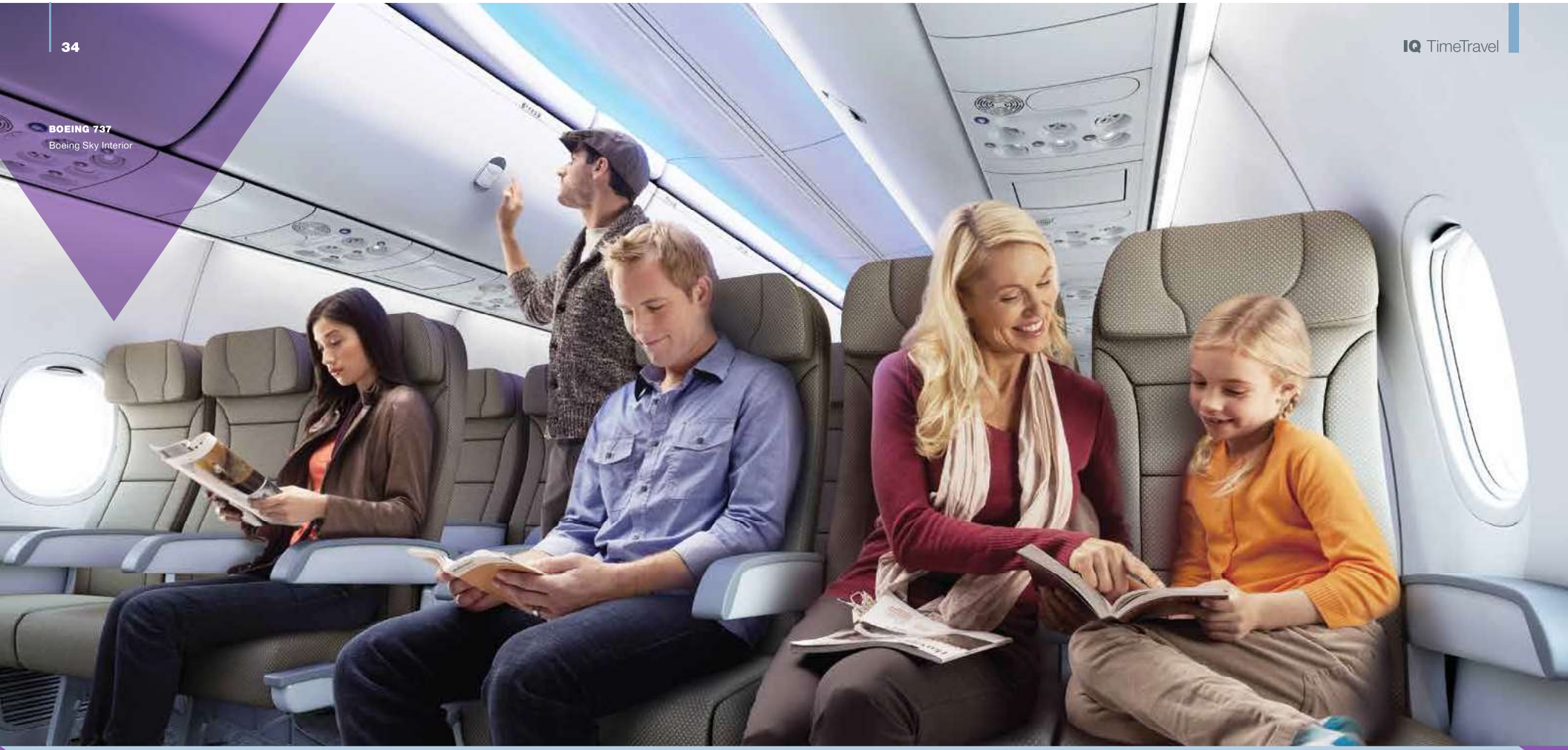
After various airplane accidents in which fire contributed to loss of life, the U.S. Federal Aviation Administration (FAA) implemented new regulations in 1984 and 1986 for fire-resistant properties. Accordingly, manufacturers began testing seat cushions for oil burn, representing a fuel-fed fire.

Additionally, testing also began on large panels throughout the cabin to evaluate heat release and smoke emission. Although these regulations initially only applied to new type certificates after the mid-1980s, all airplane cabins comply today.

In 1988, the FAA issued a regulation to require actual crash-testing of airplane seats after reviewing "areas where possible improvement in passenger safety could be achieved on transport airplanes in survivable accidents." In response, Boeing first started requiring crash-tested 16 G-force (16 times the force of gravity) seats on the 777, replacing the 9 G-force seats previously used in the industry.



DOUGLAS DC-10



BOEING 737
Boeing Sky Interior

1990s

By 1993, Boeing was developing the Next-Generation 737s — the 737-600, -700, -800 and -900. Later models of the family included the 737 Boeing Sky Interior, featuring a change in ceiling architecture, resculpted sidewalls and window reveals, and lighting to help connect passengers to the magic of flight.

2000s

The design, now the standard cabin on the 737 MAX family, offers larger, pivoting overhead bins that add to the openness of the cabin. The bins tuck up and out of the way when closed, resulting in a roomier experience. There's also an option for larger pivot bins called Space Bins — available as a production or aftermarket modification offering — that provide up to 50% more overhead storage.

Photo taken before Boeing implemented COVID-19 pandemic safeguards.
PHOTO: BOEING

All-LED cabin lighting, which brought color into the cabin as a baseline offering, was introduced on the 787 Dreamliner, which also features larger, electronically dimmable windows in lieu of window shades. Pivot bins were redesigned to maximize their volumetric size, creating a space for every passenger's bag.

The 787, the world's first commercial airplane with 50% of its primary structure made of composite materials, also introduced advanced technology enabling passengers to arrive at their destinations more rested and comfortable. The cabin environment was reinvented for the passenger, lowering the effective cabin altitude, increasing humidity in the cabin, creating cleaner air through gaseous filtration and creating a smoother ride for passengers through technology known as vertical gust suppression.

Boeing has delivered airplanes with true high efficiency particulate air (HEPA) filters since they became available for airplanes in the mid-1990s. The company's in-production airplanes all incorporate true HEPA filters in their cabin air systems. The filters remove more than 99.9% of viruses and particulates from air.

Inside the cabin, the volume of cabin air is exchanged every two to three minutes and flows primarily from ceiling to floor before leaving through the floor grilles near where it enters. Combined with seatback geometry, this cabin design helps to limit the potential spread of contaminants.

2010s

DREAM DOME

The 787 Dreamliner cabin can include an iconic full-height dome.

PHOTO: BOEING

DREAM TEAM

(From left) Interior architect Zach Kilcer, cabin marketer Brenna Wynhof and airplane product strategist Katie Faires showcase a 787 Dreamliner interior. Airline representatives can walk through the latest offerings at the Boeing Customer Experience Center in Renton, Washington.

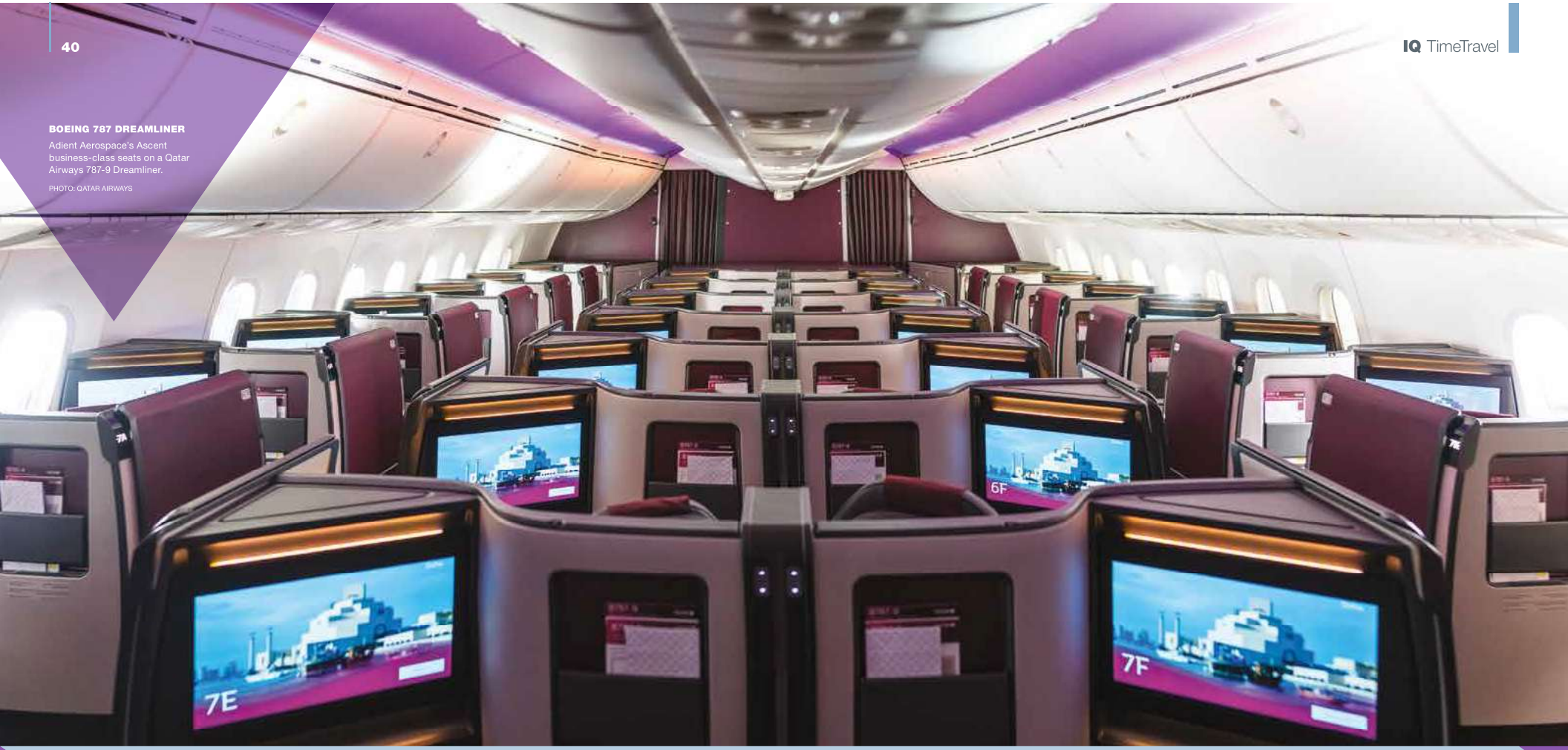
PHOTO: DAVE SIZER/BOEING

BOEING 777X OVERHEAD BINS

PHOTO: BOEING

More recent cabin enhancements include reclining seats, increasingly bigger bins (with reduced closing forces in the upcoming 777X interior), in-flight entertainment, internet access, and power outlets for laptops and other personal electronic devices. The 777X will, like its predecessor, significantly enhance the passenger experience.

BOEING 777X



BOEING 787 DREAMLINER

Adient Aerospace's Ascent business-class seats on a Qatar Airways 787-9 Dreamliner.

PHOTO: QATAR AIRWAYS

2010s

Nearly a century after passengers were willing to hop inside an airmail plane to experience the thrill of flight, Boeing continues to evolve the cabin environment. In addition to continued research and customer feedback, the company tests new technologies in its Concept Center, including the validation cabin, or "VCabin."

The VCabin demonstrator is a product development initiative designed to accelerate the technical feasibility, refinement and completion of cross-model, cross-functional cabin technologies and features that enhance the cabin experience and value of the airplane from design to end of service.

2020s

In 2016, Boeing formed a new Cabin and Interiors team focused on increasing product life-cycle value for airlines and other airplane operators by providing more options, greater capacity, improved quality and on-time delivery.

In 2018, Boeing launched the Adient Aerospace joint venture with car seat manufacturer Adient to design, manufacture and sell innovative production and retrofit aircraft seating for Boeing and other original equipment manufacturer aircraft models. Since its inception, Adient Aerospace has brought several new seating products to market, including Ascent, an award-winning lie-flat business-class seat that entered service with Qatar Airways in 2021.

In 2019, Boeing acquired EnCore, now Boeing EnCore Interiors, to expand manufacturing capabilities and market growth opportunities for other cabin products, including galleys (food and beverage preparation areas), panels, ceilings and monuments (other built-in structures).

To provide a more efficient cabin products evaluation process for its customers, Boeing EnCore Interiors recently developed a virtual interactive environment that allows airlines to easily view and model different galley design scenarios by selecting from numerous pre-qualified modular features and options.

Today, the Cabin and Interiors team includes more than 1,000 employees in multiple locations around the world, supporting development and delivery of new in-line production and retrofit seating and interiors products for both Boeing and non-Boeing commercial airplanes. Driven by continuous innovation and customer focus, the team is developing an integrated and industry-leading suite of cabin products, providing a broad array of options to enhance the passenger experience while also offering flexibility to adapt to each airline's business objectives.

Boeing Global Services also offers airplane interior modifications services and the company's own digital cabin services offering, Boeing Digital Direct, which provides wireless in-flight entertainment and e-commerce capabilities for operators.

And nearly 100 years after the Boeing Model 40A flew its first two passengers, the CST-100 Starliner team has designed a visionary passenger experience for spaceflight. Developed in collaboration with NASA's Commercial Crew Program for missions to low Earth orbit, the spacecraft offers room for seven passengers or any combination of crew and cargo. It also features wireless internet and tablet technology for crew interfaces.

The Starliner seats are some of the most advanced models ever developed for a spacecraft. Made to fit the sizes of 95% of the population, they are strong enough to bear the increased weight of launch dynamics as well as the vibrations of reentry and landing.

From sky to space, Boeing continues to invent and enable new ways to invite passengers to have a seat. **IQ**

2010s

2020s

BOEING CST-100 STARLINER

STARLINER RECLINER

Each Starliner seat is made to work in unison with the spacesuits that crew members will wear.

Photo taken before Boeing implemented COVID-19 pandemic safeguards.

PHOTO: BOB FERGUSON/BOEING