Boeing 787 Dreamliner, Made with Japan

Michael Denton
President, Boeing Japan
October 6, 2010
20-Year Market Forecast

3,090 airplanes
Medium twin-aisle

3,470 airplanes
Small twin-aisle

787-8
242 seats

787-9
280 seats

787-size airplanes represent 3,400+ market

Source: Boeing CMO 2010 - 2029
## Range, Capacity Comparison

### Seats

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### Notes

- 787 performance subject to flight test verification
- Reduced takeoff weight

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**Mid-size capacity with long-range capability**
787 Value Statement

- Higher revenue opportunities
  - Higher speed
  - More revenue cargo
  - Nonstop routes
  - Flexible seating configuration
  - Passenger preference

*Dreamliner works both sides of the value equation*
Market Leading Fuel Efficiency

Only the 787 offers this fuel use advantage
787 reduces fuel use, maintenance costs and fees
Connecting more cities non-stop

787-9
280 three-class passengers

787-8
242 three-class passengers

• Boeing typical mission rules
• 85% annual winds
• Airways and traffic allowances included
• 787 performance subject to flight test verification
Improvement Passengers Can See and Feel

- Large, spacious cabin
- Better lighting
- Large passenger windows
- More head room
- Large overhead bins
- Electronic window dimming
- Better economy seating options
- Lower cabin altitude

*Interior designed to enhance the flying experience*
Quieter Takeoffs, Landings

- Narita International Airport
- 85 dBA
- 3000nmi mission

Noise footprint stays within the airport boundaries
787 Environmental Performance

- Lower emissions
  - 20% lower carbon dioxide emissions
  - Well below regulated limits on hydrocarbons, smoke, NOX, CO

- Quieter
  - Continuous reductions in community noise
  - Ramp noise well below ICAO regulations
  - Cabin noise optimized

- Life cycle improvements
  - ISO 14001 factory, working on suppliers
  - Lean manufacturing is reducing our environmental footprint
  - Composite recycling

*Careful choices, clever design create cleaner airplane*
Innovative Technologies

- Composite primary structure
  - Doesn’t fatigue or corrode
  - Less maintenance
  - Enables new design possibilities

- Innovative systems
  - Fewer schedule disruptions
  - More efficient energy usage

- New level of aerodynamic efficiency
  - Faster with lower fuel consumption
  - Smoother ride

- Latest engine technology
  - Efficient, cleaner
  - Quieter

*Technologies enable the 787 breakthroughs*
Composite Structure

- Lighter
- More durable
- Negligible corrosion and fatigue
- Reduced scheduled maintenance
- Opens new design possibilities

Composites are the right material choice for the 787
Modern Systems Architecture

- More electric architecture
  - Efficient energy creation, distribution, consumption
  - Lower maintenance costs, improved reliability
  - Reduces fuel consumption

- e-Enabled
  - Airplane status, maintenance information easily accessible
  - Greater connectivity, on and off the airplane
  - Open data network

- Flexible reconfiguration with open software
  - Accommodates future growth, modifications

*Systems contribute as much efficiency as composites*
787 Flight Deck Design

- More operationally efficient
- Enhanced situational awareness
- Significant commonality
- Open architecture

Perfect balance of commonality and innovation
Efficient Aerodynamics

- Supercomputers allow precise modeling and refinement of aerodynamic characteristics
- Efficient shaping contributes to fuel efficiency
- Extensive wind tunnel testing conducted in multiple facilities
  - Validated computational fluid dynamics design tools
  - Verified 787 high speed and high lift design

Supercomputers, computational fluid dynamics lead to new design
Advancing Wing Technologies

- Droopable spoilers increase wing efficiency during takeoff and landing
- Variable camber for wing optimization during cruise
- Multi-function ailerons optimize the wing for takeoff and cruise
- Composite structure enables high-aspect ratio design
- Smaller fairings reduce drag
- Raked wing tips enhance wing efficiency

Attention to detail optimizes wing for performance
All-New Engines

- Higher bypass ratio
- No-engine-bleed systems architecture
- Low-noise nacelles with chevrons
- Laminar flow nacelles
- Interchangeable (at the wing)
Partners Across the Globe are Bringing the 787 Together

Partners Across the Globe are Bringing the 787 Together

U.S.  
- Boeing
- Spirit
- GE
- Goodrich

Australia  
- Boeing

Canada  
- Fuji
- Mitsubishi
- Kawasaki
- KAL-ASD

Asia  
- Boeing
- Messier-Dowty

Europe  
- Messier-Dowty
- Rolls-Royce
- Latécoère
- Alenia
- Saab

Wing tips  
Seoul, Korea

Fixed trailing edge  
Nagoya, Japan

Moveable trailing edge  
Melbourne, Australia

Wing  
Nagoya, Japan

Nacelles  
Chula Vista, CA

Mid forward fuselage  
Nagoya, Japan

Forward fuselage  
Wichita, KS

Cargo access doors  
Linköping, Sweden

Wing/body fairing  
Winnipeg, Canada

Passenger entry doors  
Toulouse, France

Tail fin  
Frederickson, WA

Horizontal stabilizer  
Foggia, Italy

Aft fuselage  
Charleston, SC

Main landing gear wheel well  
Nagoya, Japan

Center wing box  
Nagoya, Japan

Landing gear  
Gloucester, UK

Fixed and moveable leading edge  
Tulsa, OK

Engines  
GE – Evandale, Ohio
Rolls Royce – Derby, UK
787 Structures from Japan

Japanese partners providing key 787 structures
35% of the 787 is Made with Japan
Dreamlifter Enables Global Operations

- Efficient transport of 787 major sub-assemblies from international partners
- Main deck is 65,000 cubic feet
  - Three times the capacity of the 747-400 Freighter
- Reduced transportation times versus surface transportation
  - Dramatically reduced final assembly flow times
  - Less inventory – increased responsiveness to change

A massive undertaking requires massive tools
Dreamlifter Route Structure

Worldwide operations, less work in process
Final Assembly Overview

- Large structure arrives on Dreamlifter
- Pre-integration area receives assemblies
- New, simplified tooling concepts deployed
- Four positions from start of Final Assembly to finish
- Final body join in Position 1
- Floors, hydraulic and electrical systems installations in Position 2
- Interiors, engine hang, and power-on in Position 3
- Interiors completion and production testing in Position 4

*It all comes together in Everett*
Rigorous Testing Program

- Laboratory testing proves material properties, systems performance
- Flight test puts integrated systems through their paces
- Static test demonstrates strength of structure
- Fatigue test validates durability of structure

*Testing program begins with small samples, grows to full-scale*
Flight Testing

- Six airplanes in flight test fleet
  - Five have flown

- Tests cover a range of operating conditions
  - Hot weather
  - Cold weather
  - Wet conditions
  - High altitude
  - Takeoff and landing
  - Short hops
  - Long-range flights

Test plan includes more than 3,000 hours of flying
Flight Testing Milestones

- Initial airworthiness | Jan 2010
- Flutter testing | Mar 2010
- Ground effects testing | Mar 2010
- Ultimate wing test | Mar 2010
- Expanded TIA | Apr 2010
- Extreme weather | Mar 2010
- Icing testing | May 2010
- AP 5 first flight | Jun 2010

More than 500 flights and 1,800 flight hours
Unprecedented Market Response

847 orders from 55 customers

As of 5 August, 2010

* Leasing operator
Revised First Delivery Schedule

- Flight test instrumentation delays
  - Planned instrumentation layups earlier this year took more time than anticipated
  - No current issues with instrumentation

- Supplier workmanship
  - Findings related to horizontal stabilizer workmanship issues and documentation of the build status
  - Inspections of flight test airplanes completed quickly, but reduced schedule margin

- Delay in engine availability
  - Engines needed later in the program would not be available in time to support the testing schedule

Cumulative impact of a series of issues contributed to the delay
Program Schedule

- First delivery ... mid-first quarter 2011
- 787-9 first delivery ... late 2013

Team focused on clear expectations, progress continues
The First Customer to Fly

ANA captains Tsukamoto and Ishii