Boeing Product Update

August 2018
Agenda

- Market Outlook
- Boeing Product
- Impact to Airports
- 777X – Folding Wingtip
- Boeing Airport Compatibility Group 2 – Regulatory Effort
CURRENT MARKET OUTLOOK
2017–2036
Market Outlook (Latin America)

The economic outlook for the Latin America region continues to improve after an extended period of challenges. Among the top countries in the region, Brazil and Argentina continue their post-recession rebounds and Mexico is experiencing modest economic growth. The long-term growth prospects for Colombia, Chile, and Peru remain strong.

Aviation in Latin America is entering a dynamic period. The economic recovery and growth opportunities in air travel have generated renewed interest in low-cost carriers (LCCs) in the region. The availability of competitive low fare LCC flights, coupled with a larger middle-class population, is shifting from slower modes of transportation to air travel.

Further liberalisation is on the horizon, and airlines are forming strategic alliances to take advantage of these opportunities. Mexico and the United States established an Open Skies agreement in 2017, and Brazil-US Open Skies approval is imminent. Numerous cross-airline joint ventures are being formed or planned. Avianca and Delta Air Lines have already established a joint operating agreement under antitrust immunity, and the Brazil-US agreement is likely to pave the way for similar business arrangements. Partnerships and cross-airline equity arrangements are being formed or discussed between airlines in Latin America and other regions as well.

**Deliveries 2018-2037**

- **87%** Deliveries into Latin America forecast to be single-aisle airplanes, the highest percentage among all regions.

**Fleet Composition**

- **2017**
  - Freighter: 6% (4)
  - Widebody: 10% (83)
  - Single aisle: 80% (1,040)
  - Regional jet: 4% (70)

- **2037**
  - Freighter: 4% (50)
  - Widebody: 8% (333)
  - Single aisle: 84% (3,010)
  - Regional jet: 4% (140)

**Market Value**

- **$360B**

**GDP**

- **3.0%**

**Traffic**

- **5.9%**

**Fleet**

- **4.2%**

**Deliveries**

- **3,040**

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Boeing Product

737 Family

Over 100 Customers & 4664 Orders

737-MAX 200
- MAX 8 with mid/aft exit door
- 200 PAX

The whole design matters
- Less weight
- Improved aerodynamics
- New LEAP-1B engine

737 MAX 10
- 5 ft (1.6m) Longer
- 230 Pax
- 2020 EIS

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787 Family: 71 Customers, Over 1,387 Orders
787-10: Over 171 Orders

787-9
290 passengers
7,635 nmi (14,140 Km)
EIS: Oct 2016

787-10
330 passengers
6,430 nmi (11,910 Km)
EIS: Mar 2018

787-8
242 Passengers
7,355 nmi (13,620 Km)
EIS: Dec 2014
Opening New Non-stops With the 787 Dreamliner Family

With its unparalleled fuel efficiency and range flexibility, the 787 Dreamliner family is helping airlines open new nonstop routes profitably. With more than 170 new non-stops in service and announced — and counting, the 787 family is connecting people and cities around the world while meeting passengers’ expectations to fly nonstop.

170+ new routes as of 2017.
Boeing Product
Demand for Capacity & Efficiency

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<thead>
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<th>Seats</th>
<th>Current Boeing</th>
<th>Future Boeing</th>
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<tr>
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<tr>
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<td>737-700</td>
<td>737 MAX 8</td>
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Impact to Airports
Impacts to Airports

- Grp V (Code E) vs Grp VI (Code F)
- Cost of upgrades are prohibitive
- Physical restrictions – insufficient land area, surrounding communities
- Over 200 airports accommodate Grp VI (Code F) operations today using exceptions and operational plans
- Today’s approach of accommodation may not be sufficient as quantity of large aircraft increases

- Wingspan – separations and clearances
- Overall Length – TDG category, gate length, stop lines, PBB and servicing equipment, RFF
- Weight – pavement strength, runway length, approach category, wake turbulence
Impacts to Airports

747-8

Capability

- Freighter EIS 2011 / Passenger 2012
- Increased Cargo / Passengers
- Increased fuel efficiency and range
- Lower emissions, noise and operating cost

Challenges

- 247 ft Length (+18 ft)
- 224 ft (68.4m) Wingspan (+13 ft, Group VI / Code F)
- 2008 - Airport assessments, Regulatory meetings
- 124 CAAs, Approval at 462 airports
- 17 Airline customers operating 124 aircraft
- Regular revenue service into 213 airports
Wingspan vs Entry into Service Year (Separations)
Overall Aircraft Length vs Width (RFF)

August 2018
Widebody Aircraft vs MTW

[Bar chart showing MTW (in KG) for different aircraft types and years from 1982 to 2020.]
777X – Folding Wingtip
As the demand for greater operating efficiency has driven manufacturers to combine technological advances with increases to wingspans, successive new aeroplane models in each code letter category have increased wingspan to the span limit of the corresponding Aerodrome Reference Code letters.
Folding Wing Tip

- Folding wing tips / wings have been found on military aircraft since the 1930s to offset the limited parking available aboard aircraft carriers.

- A folding wing was offered on the original 777-200 (mid-1990s), reducing the wingspan from Code letter E to Code letter D so that it could fit into a gate designed for DC-10.
In order to balance the improved benefits to the airlines with any potential impacts to the aerodrome infrastructures, manufactures have to incorporate aerodrome compatibility into the design of aeroplanes.

**Folding Wing Tip**

- Longer wing spans improve aerodynamic efficiency and reduce fuel burn

  *BUT...*

- Longer wing spans create aerodrome compatibility issues

  **THEREFORE:**

- A Folding Wing Tip (FWT) maximizes aerodrome compatibility and retains aerodynamic efficiency and fuel burn reduction
A balanced design approach, focused on efficiency

- Combining proven and leading edge technologies

777 Technologies
- Highly reliable systems architecture
- Composite floor beams and empennage
- Composite wing

787 Technologies
- Laminar flow nacelle
- Advanced flight controls and high lift design
- Flight deck displays and functionality
- Computing and Network Architecture

NEW Technologies
- High span composite wing with folding tip
- Clean sheet engine design
- New passenger experience
Unparalleled aerodynamic efficiency

Laminar flow nacelles
Reduced drag with smoother airflow over nacelles

Folding wingtip
Simple and reliable; maximizes efficiency while maintaining taxiway and gate compatibility

Next generation wing
All new high aspect ratio composite wing with advanced high lift system
Span: 7 meters longer than 777-300ER
Area: 21% greater than 777-300ER
777X payload and range capability

**777-8**
351,530-kg (775,000-lb) MTOW
350-375 passengers

**777-200LR**
347,450-kg (766,000-lb) MTOW
300-325 passengers

**777-9**
351,530-kg (775,000-lb) MTOW
400-425 passengers

**777-300ER**
351,530-kg (775,000-lb) MTOW
375-400 passengers

While improving on today’s gold standard 777-300ER:
- 20% fuel burn improvement
- Maintenance improvement
- Dispatch reliability
- Passenger experience

August 2018
GE9X advantage … selected to power the 777X

Exclusive GE Technologies

- Composite fan
- Compressor: 16 blades, 27:1 pressure ratio
- Lean combustion: 29% NOx, 20% CAEP/8 margin
- Ceramic-matrix composites (CMCs): 20% greater thermal capability

LOWER Fuel Burn

GE90 Comparable Maintenance Cost

10% versus -300ER
777-9 Quieter for the Community

• 85dBA Takeoff Noise Contours, MTOW mission

• 777-300ER levels are based on Certified Noise database.

• 777-9 levels are predicted levels based on the noise model.

• Based on a 10,000 ft (3,048 meter) long runway.
777-9 Quieter for the Community

- 85dBA Approach Noise Contours at MLW

- 777-300ER levels are based on Certified Noise database.
- 777-9 levels are predicted levels based on the noise model.
- Based on a 10,000 ft (3,048 meter) long runway.
# 777X timeline

<table>
<thead>
<tr>
<th>Launch</th>
<th>Firm configuration</th>
<th>Production begins</th>
<th>First delivery</th>
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<tr>
<td>2013</td>
<td>2014</td>
<td>2015</td>
<td>2016</td>
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- **Top-level design**
- **Detailed design**
- **Flight test**
777X Airport Destinations
Boeing Airport Compatibility Group 2 – Regulatory Effort
Boeing Airport Compatibility Group 2 (BACG2)

777-9 – Folding Wingtip Concept of Operations (Available @ ACI – World website)
Regulatory Updates

- ICAO Annex 14 Aerodrome Design Document – Proposed language that will refer to PANS-Aerodrome (ICAO Doc 9981), and Annex 4 (Ground Maneuvering Charts)

- PANS-Aerodrome contains guidance and processes for larger-coded aircraft operating into lesser-coded airports, and will refer to manufacturers’ ACAP documentation

- 777X ACAP contains the Folding Wing Tip Concept of Operations (FWT ConOps), Functional/Operational specifications, and Recommended operations at airports (Standard and Non-normal)  

- Boeing BACG2 document for the 777X aircraft will provide assistance with regulatory compliance (Publication – Aug 2018)

- FAA EB94 will describe FWT operations at US airports  

Please visit the Boeing Airport Compatibility Engineering website:

www.boeing.com/airports

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