World Titanium Demand Trends in Structures

Jeremy Halford, President, Arconic Engineered Structures

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The large commercial aircraft market has never been this good

*Boeing and Airbus
Source: The Airline Monitor, June 2018 (includes Large Commercial Aircraft + Regional Jets)

Record Everything

Deliveries: ~1,500 aircraft in 2017*

Absolute Backlog: 13,000 units*

Relative Backlog: Nine years of production at 2017 delivery rate

Outlook: LCA deliveries are ahead of 2017’s YTD pace.
Near-term outlook is supported by years of strong orders

2017 saw a resurgence of orders with more than 2000 new aircraft booked and a year-end book to bill of ~1.5; 2018 shows continued strength as orders are already up 25% vs the 2017 YTD comparison

The enormous wave of net orders post financial crisis were the product of three drivers:

- High jet fuel prices
- Low interest rates
- New, more fuel-efficient aircraft designs

Source: Airline Monitor, June 2017; Airbus and Boeing websites
Long-term outlook projects 42K+ new aircraft over next 20 years

- Results in a 2037 fleet of 48,540 aircraft – approximately 2X what it is today
- Dollar value pegged at $6.3 trillion

Region: 6% of deliveries | 2% of market value
Single Aisle: 73% of deliveries | 55% of market value
Widebody: 19% of deliveries | 39% of market value
Freighters: 2% of deliveries | 4% of market value

Source: Boeing 2018 Commercial Market Outlook
Airline forecasts are reinforced by strong air traffic demand growth

2017 Industry Growth Drivers

- Industry growth drivers show **continued strength**
- By 2037, an estimated 85% of emerging country populations will fly, up from 30% in 2017

World Annual Airline Traffic and RPKs¹

- Travel demand projected to far outpace GDP growth
- Traffic has proved to be resilient to external shocks; doubles every 15 years

¹) In trillions of Revenue Passenger Kilometers; Source: Airbus 2018 Global Market Forecast
Fuel prices have been increasing, but they are within a “sweet spot”

- High enough to encourage airlines to continue to **purchase more fuel-efficient models**
- But not so high as to raise ticket prices that would discourage air travel demand
Positive outlook is bolstered by the airlines’ ability to pay for aircraft

- Projected **profitability of nearly $34B** in 2018; airlines maintaining focus on generating **increased ROIC**

- Strong drivers of above-average **passenger growth (~7% YTD)** and rising passenger **load factors (>80%)**

- Higher fuel prices take a toll on airline profitability, but upward trend continues to support investment in newer, more fuel-efficient models

Source: IATA, June 2018
Titanium growing at CAGR of 4.3% through 2020

- **Next-gen** aircraft shifting to greater use of composites in wing and engine structures

- **Titanium growing** in conjunction with composites due to the materials’ **compatible properties**

- **Raw material demand** growth measured in volume (lbs) will be **lower than aircraft** unit growth due to:
  - Lower **buy-to-fly** ratios
  - Greater use of composites

- **Titanium** will grow the **fastest** among metals with CAGR of 4.3%
The supply side challenge is how to profitably deliver the backlog.

### Era of Design to Era of Delivery

- **Industry shift:** Era of Design to Era of Delivery
- **Supply Chain / “Teething” Issues:** How to keep pace with the ramp
- **The Supplier Squeeze:** Pressure to reduce costs and improve efficiency
- **Industry Restructuring:** M&A activity across the sector is picking up speed and insourcing decisions are becoming the norm

### Unprecedented Number of New Product Introductions

<table>
<thead>
<tr>
<th>Approximate New Aircraft Entries Into Service</th>
<th>Approximate New Engine Entries Into Service</th>
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<tr>
<td>![Graph showing aircraft entries]</td>
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- **Source:** OEM announcements
Multi-step value streams support product and process innovation

Arconic Engineered Structures
Delivering complete, lightweight, multi-material solutions from raw material to finished part

Melt & Mill
- Billet
- Ingot
- Plate
- Sheet

Mid-Stream Operations
- Extrusions
- Castings
- Additive Mfg.
- Forming

Machining, Assembly & Service Centers
- Machining
- Assembly
- Service Centers

ARCONIC
Product and process innovation will help drive titanium growth

**Product Innovation**

**Challenge:** Next-gen engines running hotter; challenge for adjacent structures

**Opportunity:** Higher-temp Ti solution

**Innovation:** ARCONIC-THOR™
50% lighter than incumbent Ni superalloys

**Process Innovation**

**Challenge:** Pressure to ↓ costs, ↑ efficiency

**Opportunity:** Metal additive manufacturing

**Innovation:** Arconic 3D printed titanium bracket flying on Airbus aircraft
ARCONIC
Innovation, engineered.