Outlook For Aerospace Titanium

Flying Into Headwinds

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Partner

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Agenda

Aerospace Demand Outlook

The Influence Of The Aftermarket

The Green Challenge
The Aerospace Industry Is Coming Off A Strong 2008, With Nearly 4,500 Aircraft Deliveries…

2008 Aircraft Production
4,446 Units

By OEM

- CESSNA 569
- SIKORSKY 160
- AGUSTA 118
- BELL 167
- ECLIPSE 209
- EMBRAER 222
- BOMBARDIER 297
- HAWKER BEECHCRAFT 313
- OTHER 839

By Market

- AIRBUS 1,063
- AIR TRANSPORT 1,069
- MILITARY FIXED WING 446
- BUSINESS & GENERAL AVIATION 1,868

Sources: AeroStrategy, Teal Group
However, the air transport production outlook has deteriorated significantly with the recession... The global economic recession coupled with deteriorating airline balance sheets and a credit crisis, will lead to a downturn in deliveries.

AeroStrategy projects air transport deliveries to fall below 1,000 units by 2011 – a 15+% decline from a peak in 2009.
The business aviation sector will experience the steepest decline in production of any market sector.

The 2008 backlog of 5,000+ aircraft has deteriorated significantly whilst nearly 20% of bizjet fleet is for sale.

Production rates are projected to decline 40-50% in the 2010-2013 trough.
In Contrast, Military Aircraft Production Is Expected To Be Relatively Steady

Military Aircraft Production Forecast 2008-2019

- Unit military aircraft production should be relatively flat over the next three-five years
- Huge government deficits will likely reduce military aircraft procurement in the long run
- A major wildcard is the A400 transport, which could be delayed to 2014....or beyond
The Aerospace Industry “Buy Weight” Is ~ 950 Million Pounds For All Materials

2008 Aerospace Raw Material Demand (M Lbs)*

- The total buy weight in 2008 was 950 million lbs based on a “fly weight” of 170 million lbs.
- Aluminum accounts for 45% of demand, followed by steel (23%), titanium (11%), and nickel (11%).
- Composites are just 4% of buy weight, aided by relatively low revert levels for composite production.

* Based on 2009 production rates; assumes 12 month lag between aircraft production and material demand from mill.

Source: AeroStrategy
**The Air Transport Sector Accounts For 70% Of Total Aerospace Material Demand**

- 68% of total raw material demand is from the air transport sector.
- The declining business & general aviation sector accounts for 13% of demand – the same as military fixed wing.
- Rotary wing is just 6% of total demand.

### 2008 Aerospace Raw Material Demand (M Lbs)*

- **Air Transport**: 644.0M Lbs (68% of total)
- **Business & General Aviation**: 124.2M Lbs (13% of total)
- **Military**: 124.3M Lbs (13% of total)
- **Rotary Wing**: 56.6M Lbs (6% of total)

* Assumes 12 month lag between aircraft production and material demand from mill.

Source: AeroStrategy

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Aerospace Titanium Outlook
Aggregate Aerospace Material Demand Is Expected To Bottom Out In 2010 Before Recovering

Demand is forecasted to recover from the 2009/2010 trough to 1.2 billion lbs by 2012

Titanium and composites will be the two fastest growing material categories

Aluminum will remain a growth market despite growing encroachment from composites

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**Aerospace Buy Weight - All Materials***

(M Lbs)

- Composites
- Other Metals
- Nickel
- Titanium
- Steel
- Aluminum

<table>
<thead>
<tr>
<th>Material</th>
<th>CAGR</th>
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<tbody>
<tr>
<td>Aluminum</td>
<td>3.3%</td>
</tr>
<tr>
<td>Steel</td>
<td>3.1%</td>
</tr>
<tr>
<td>Titanium</td>
<td>9.6%</td>
</tr>
<tr>
<td>Nickel</td>
<td>4.3%</td>
</tr>
<tr>
<td>Other Metals</td>
<td>0.0%</td>
</tr>
<tr>
<td>Composites</td>
<td>9.5%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>4.2%</td>
</tr>
</tbody>
</table>

* Assumes 12 month lag between aircraft production and material demand from mill

Source: AeroStrategy
Underlying Demand For Titanium, Excluding The Impact Of Destocking, Will Decline 10%...

AeroStrategy anticipates an upturn in production rates in 2012.

Assuming a one year lag from mill shipment to aircraft production...this implies that Ti demand should increase in 2011 production.

Delivery of the B787 (anticipated early 2011) will contribute to the upswing.

* Assumes 12 month lag between aircraft production and material demand from mill.

Aerospace Titanium Demand by Market*
(M Lbs)

- Aerospace Titanium Outlook © 2009 AeroStrategy

Source: AeroStrategy
Supply chain destocking hits upstream mills especially hard during downturns.

This phenomenon combined with delays in high Ti content aircraft (B787, A380) lead to volume reductions of 20-30% or more for titanium suppliers in 1H 2009.
Agenda

Aerospace Demand Outlook

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The Green Challenge
The Aftermarket Comprises Nearly 10% Of Aerospace Ti Demand

2009 Aerospace Titanium Demand By Market

- Rotary Wing Production: 4%
- Military Fixed Wing Production: 15%
- Business & GA Production: 4%
- Aftermarket: 8%
- Air Transport Production: 68%

Source: AeroStrategy
## Three Maintenance, Repair & Overhaul (MRO) Activities Drive Aftermarket Consumption Of Raw Materials

### Engines

- Major scheduled events (overhaul, hot section inspection)
- Material intensive; engine parts are 60-70% of the cost of engine MRO
- Disks and hubs are life limited and must be destroyed after cycle limits
- Major materials: nickel alloys, titanium, steel

### Components

- Maintenance for aircraft systems and components
  - Avionics
  - Auxiliary power unit
  - Landing systems
  - Hydraulics, pneumatics, fuel
- Generally material intensive
- Major materials consumed: aluminum, nickel alloys, steel, titanium, composites

### Airframe Heavy

- Scheduled airframe heavy checks and depot-level maintenance
- Labor-intensive; labor is typically 70% of cost structure
- Major materials consumed: aluminium, composites

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*Aerospace Titanium Outlook © 2009 AeroStrategy*
Air Transport Maintenance Spending Is Forecast To Decrease Seven Percent In 2009

2003-2009 Global MRO Market ($B)

- Modifications
- Airframe
- Components
- Line
- Engine

7% decline from 2007 - 2009

Source: AeroStrategy/OAG Aviation
Operators Have Several Options For Reducing Maintenance Spending In Times Of Crisis…

<table>
<thead>
<tr>
<th>Engines</th>
<th>Components</th>
<th>Airframe Heavy</th>
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<tbody>
<tr>
<td>- Reduced scope of maintenance – more “repair” and less “replace”</td>
<td>- Burn down rotable inventory in lieu of component MRO repair</td>
<td>- Reduce utilization and rotate in-service aircraft to minimize heavy maintenance checks required by hour/cycle limits</td>
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<tr>
<td>- Defer replacement of expensive life limited parts until they reach absolute cycle limits (e.g., short-stub engines)</td>
<td>- Reduced scope maintenance – more “repair” and less “replace”</td>
<td>- Park older aircraft approaching expensive heavy checks</td>
</tr>
<tr>
<td>- Greater leverage of spare engines in lieu of overhauls</td>
<td>- Acquisition of surplus rotables for mature aircraft</td>
<td>- Reduce discretionary modifications (e.g. Interior upgrades, painting)</td>
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<tr>
<td>- Acquisition of surplus engines for mature aircraft</td>
<td>- Renegotiate MRO contracts</td>
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And there is a significant amount of inventory in the MRO supply chain—more than $40 billion...

2008 Air Transport MRO Demand & Supply Chain Inventory*

- AeroStrategy estimates the amount of MRO supply chain inventory is $44 billion—larger than current MRO spending!
- A small liquidation of this inventory in lieu of MRO spending can have a significant impact on MRO demand.
- This inventory costs the industry in excess of $10 billion annually.

Source: AeroStrategy/OAG Aviation
* Inventory estimates based on a 2005 global supply chain survey conducted by AeroStrategy and Overhaul & Maintenance.
As a result, raw material suppliers could see a 20-40% reduction of aftermarket demand.

Fundamental MRO demand down 6% in 2009

Near-term reduction in supplier revenues:

- (10 – 15%)
- (15 – 30%)
- (20 – 40%)

- OEM civil aftermarket revenue (a combination of maintenance services and parts) declined 18% in 2Q 2009 for the air transport sector.
- AeroStrategy estimates that raw material supplies will see a 20-40% reduction in 2009 aftermarket demand due to supply chain destocking and deferred maintenance.
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Three Main Factors Are Driving Demand For "Greener" More Fuel Efficient Aircraft

Factors Driving Greener Aircraft

**Economics**
- Airline Operating Costs
- Fuel represents 30-40 percent of an airline’s operating expenses...up considerably from pre-2007 levels
- Massive airline losses in 2009 add to the pressure to reduce operating costs

**Regulation**
- Aviation included in EU ETS from 2012
- Growing momentum to reduce CO² in the U.S. including the possibility of cap-and-trade regulation

**Public Perception**
- Aviation viewed in Europe as major emissions offender
- Airlines responding by committing to CO² reductions

Source: AeroStrategy
The Drive For Weight Savings Will Drive Greater Use Of Titanium... In More Than Just Aerostructures

The B787 Weight Breakdown (excluding engines)

- Primary Aerostructures: 39%
- Interiors: 14%
- Components: 32%
- Secondary Aerostructures: 3%
- Hardware: 2%
- Nacelle Systems: 10%

Most industry press focuses on high use of titanium (and carbon fiber composites) in aerostructures.

However aircraft components, interiors and hardware combined account for about half of the empty weight of an aircraft (excluding engines)....these will be new “hunting grounds” for Ti suppliers.

* Average empty weight for B787-300 and B787-8/900 models used

Source: AeroStrategy
The Net Impact Of “Green” Is Positive For Aerospace Titanium Demand

Impact Of Green On Aerospace Titanium Demand

- Greater airline need to replace older, less efficient aircraft – softens impact of down cycle
- Premium for lower weight, higher Ti content aerostructures
- Need for Ti usage in new systems
- Increases demand for newer generation aircraft

- Higher airline fuel costs (via carbon taxes)
- Air travel demand elasticity: higher costs = less air travel demand
- Aviation public relations challenges

Green is a net positive for aerospace titanium demand
• The air transport market – the key driver of titanium demand – is expected to see a nearly 20% decline in unit production by 2011

• The production downturn coupled with supply chain destocking and new aircraft delays has resulted in a drop in Ti mill demand of 20-30%...or more

• Aerospace titanium demand is expected to resume growth in 2012

• The aftermarket accounts for an estimated 8% of aerospace titanium demand...and is witnessing supply chain destocking phenomenon similar to manufacturing

• The next impact of the “Green” is positive for aerospace titanium
AeroStrategy is a specialist management consulting firm devoted to aviation and aerospace sectors with offices in Ann Arbor, Amersham, U.K., and Singapore.

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