Aircraft retirements and part-out
Effective use of existing trends and opportunities in the market

15 September 2016
Bangkok
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    - Components value and demand
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Group overview

Our locations and services

**Client base**
- 150+
- 37% Airlines
- 63% Lessors & financiers

**Management**
- 30+ aircraft under management

**Services**
- Technical services
- Engine management
- Asset management
- Consulting services

**SGI Amsterdam**
- Asset management
- Aircraft & Engine technical services
- Business jets
- Consulting
- Regulatory services

**SGI Singapore**
- Aircraft & Engine technical services
- Business jets

**SGI Americas**
- Technical services
- Engine services

**2015 Engagements**
- Annual: 41
- Pre purchase: 35
- Valuation: 60
- Redeliveries: 45

**Client base**
- 150+

**Attendance**
- 45+ Over 45 experts, located on almost all continents
- 30+ Local experts in 15 countries who speak the language & know the culture
- 150+ More than 100 inspections performed, including 45 aircraft redeliveries in 2015
- 150 Over 150 engines inspections, including management of 20 shop visits
- 7,500 More than 7,500 inspection days performed in 2015
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Introduction

Technical life ≠ Economic life

- **Design Service Goal** or **Design Service Objective (DSG/DSO)** is the period of time during which the principal structure will be reasonably free from significant cracking
  - This is established at design or certification
  - The DSG/DSO is expressed in Flight Hours or Flight Cycles

- **Limit of validity (LOV)** is the period of time up to which it has been demonstrated that widespread fatigue is unlikely to occur in an airplane’s structure
  - This is by virtue of its design and required maintenance actions
  - The LOV is also expressed in Flight Hours or Flight Cycles

- Operation beyond the DSG/DSO requires an extensive inspection program


Note: Retired aircraft have an assumed annual utilization of 3,000 FH.
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Historical trends

The increasing world fleet will result in an increase of aircraft retirements over the next decades

- The number of commercial aircraft in service has increased from approximately 12,000 in 1980 to more than 27,000 by the end of 2015
- From 1980 to 2015, more than 15,000 commercial aircraft have been retired worldwide
  - The compound annual growth rate was more than 4%
- The average age of aircraft in service has been relatively stable in the last 15 years, albeit with a decreasing trend in the last 5 years;
- As a result of the growing young world fleet, there will be increasing amount of aircraft removed from service and subsequently retirements over the upcoming years;

Number of aircraft in service and average age (1980-2015)

Aircraft retirements and retirement age (1980-2015)

Source: SGI Aviation analysis, internal databases and Ascend database
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The average retirement age for commercial aircraft over the last 36 years was 26.5 years;

More than half of the aircraft are retired between the age of 20 and 30 years;

About 10% of the aircraft were retired before the age of 15 during the analysed term;

Another some 10% of the aircraft went out of service after the age of 37;

More than 50% of the aircraft are still in operation at the age of 25 years;

Source: SGI Aviation analysis, internal databases and Ascend database
Freighters tend to be retired later than passenger aircraft

- **Total retirement:**
  - Passenger aircraft: 82%
  - Freight aircraft: 17%
  - 39% (1,046 aircraft) were converted freighters.

- **Significant differences between passenger and freight aircraft retirement:**
  - Average retirement age: freighters (32.5), passenger aircraft (25.1);
  - Surviving rate at age 33: freighters (50%), passenger aircraft (13%);

- **Freighter conversion:**
  - Average conversion age: 18
  - 10 to 20 years of extended life
  - Low utilisation

Source: SGI Aviation analysis, internal databases and Ascend database
Retirement age distribution (3/4)

There are differences in retirement age of narrow body, wide body and small aircraft.

Retirement age distribution of small aircraft (1980-2015)

- Retirement share: 39%
- Average retirement age: 25.6

Retirement age distribution of narrow body aircraft (1980-2015)

- Retirement share: 47%
- Average retirement age: 27.4

Note: Aircraft with 100 seats or less are classified as small aircraft & aircraft with 100 to 200 seats are classified as narrow body aircraft.
Source: SGI Aviation analysis, internal databases and Ascend database.
Retirement age distribution (3/4)

There are differences in retirement age of narrow body, wide body and small aircraft


Retirement share: 14%
Average retirement age: 25.5

% of retired fleet by ages and aircraft types (1980-2015)

Note: Wide body aircraft are classified as aircraft with 200 seats or more
Source: SGI Aviation analysis, internal databases and Ascend database
Retired types of aircraft (1/2)

The aircraft types of which a medium portion has been retired will drive the retirement in the short-term future.

Manufacturer’s locations of retired aircraft (1980-2015)

Top 20 aircraft retired (till 31/12/2015)

<table>
<thead>
<tr>
<th>Aircraft type</th>
<th># retired</th>
<th>% retired</th>
<th>Average retirement age</th>
</tr>
</thead>
<tbody>
<tr>
<td>727</td>
<td>1492</td>
<td>84%</td>
<td>31.4</td>
</tr>
<tr>
<td>737-100/200</td>
<td>810</td>
<td>75%</td>
<td>30.3</td>
</tr>
<tr>
<td>An-24</td>
<td>760</td>
<td>69%</td>
<td>30.3</td>
</tr>
<tr>
<td>DC-9</td>
<td>725</td>
<td>78%</td>
<td>35.2</td>
</tr>
<tr>
<td>747</td>
<td>714</td>
<td>48%</td>
<td>27.1</td>
</tr>
<tr>
<td>737 CL</td>
<td>670</td>
<td>34%</td>
<td>22.7</td>
</tr>
<tr>
<td>Tu-154</td>
<td>648</td>
<td>78%</td>
<td>22.9</td>
</tr>
<tr>
<td>Yak-40</td>
<td>629</td>
<td>67%</td>
<td>25.9</td>
</tr>
<tr>
<td>MD-80</td>
<td>490</td>
<td>41%</td>
<td>24.0</td>
</tr>
<tr>
<td>707</td>
<td>456</td>
<td>63%</td>
<td>24.5</td>
</tr>
<tr>
<td>Tu-134</td>
<td>453</td>
<td>82%</td>
<td>25.4</td>
</tr>
<tr>
<td>L-410 Turbolet</td>
<td>453</td>
<td>61%</td>
<td>16.8</td>
</tr>
<tr>
<td>Il-18</td>
<td>440</td>
<td>83%</td>
<td>24.1</td>
</tr>
<tr>
<td>DC-8</td>
<td>430</td>
<td>78%</td>
<td>31.7</td>
</tr>
<tr>
<td>A300</td>
<td>276</td>
<td>49%</td>
<td>24.5</td>
</tr>
<tr>
<td>Viscount</td>
<td>273</td>
<td>62%</td>
<td>21.7</td>
</tr>
<tr>
<td>DC-10</td>
<td>268</td>
<td>71%</td>
<td>30.3</td>
</tr>
<tr>
<td>A320</td>
<td>266</td>
<td>6%</td>
<td>20.1</td>
</tr>
<tr>
<td>F.27</td>
<td>253</td>
<td>57%</td>
<td>32.2</td>
</tr>
<tr>
<td>L-1011 TriStar</td>
<td>221</td>
<td>89%</td>
<td>26.8</td>
</tr>
</tbody>
</table>
Retired types of aircraft (2/2)

America and Europe built aircraft with low retirement rate are projected to shape the long-term market

Retirement rate by manufacturer’s locations (till 31/12/2015)

<table>
<thead>
<tr>
<th>Manufacturer’s location</th>
<th># of aircraft manufactured</th>
<th>% of aircraft retired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td>28,674</td>
<td>29%</td>
</tr>
<tr>
<td>Europe</td>
<td>16,520</td>
<td>23%</td>
</tr>
<tr>
<td>USSR/CIS</td>
<td>6,134</td>
<td>70%</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>596</td>
<td>47%</td>
</tr>
</tbody>
</table>

Source: SGI Aviation analysis, internal databases, Ascend database

Top 20 aircraft delivered (till 31/12/2015)

<table>
<thead>
<tr>
<th>Aircraft type</th>
<th># delivered</th>
<th># retired</th>
<th>% retired</th>
<th>Av. retirement age</th>
</tr>
</thead>
<tbody>
<tr>
<td>737 NG</td>
<td>5478</td>
<td>54</td>
<td>1%</td>
<td>12.6</td>
</tr>
<tr>
<td>A320</td>
<td>4115</td>
<td>266</td>
<td>6%</td>
<td>20.1</td>
</tr>
<tr>
<td>737 CL</td>
<td>1979</td>
<td>670</td>
<td>34%</td>
<td>22.7</td>
</tr>
<tr>
<td>727</td>
<td>1775</td>
<td>1492</td>
<td>84%</td>
<td>31.4</td>
</tr>
<tr>
<td>747</td>
<td>1492</td>
<td>714</td>
<td>48%</td>
<td>27.1</td>
</tr>
<tr>
<td>A319</td>
<td>1382</td>
<td>23</td>
<td>2%</td>
<td>14.0</td>
</tr>
<tr>
<td>777</td>
<td>1355</td>
<td>20</td>
<td>1%</td>
<td>16.8</td>
</tr>
<tr>
<td>A321</td>
<td>1222</td>
<td>21</td>
<td>2%</td>
<td>16.9</td>
</tr>
<tr>
<td>MD-80</td>
<td>1190</td>
<td>490</td>
<td>41%</td>
<td>24.0</td>
</tr>
<tr>
<td>Dash 8</td>
<td>1123</td>
<td>69</td>
<td>6%</td>
<td>17.9</td>
</tr>
<tr>
<td>An-24</td>
<td>1100</td>
<td>760</td>
<td>69%</td>
<td>30.3</td>
</tr>
<tr>
<td>737-100/-200</td>
<td>1078</td>
<td>810</td>
<td>75%</td>
<td>30.3</td>
</tr>
<tr>
<td>767</td>
<td>1064</td>
<td>160</td>
<td>15%</td>
<td>24.5</td>
</tr>
<tr>
<td>757</td>
<td>1039</td>
<td>101</td>
<td>10%</td>
<td>24.3</td>
</tr>
<tr>
<td>CRJ RJ</td>
<td>1021</td>
<td>146</td>
<td>14%</td>
<td>14.2</td>
</tr>
<tr>
<td>Yak-40</td>
<td>942</td>
<td>629</td>
<td>67%</td>
<td>25.9</td>
</tr>
<tr>
<td>DC-9</td>
<td>931</td>
<td>725</td>
<td>78%</td>
<td>35.2</td>
</tr>
<tr>
<td>Tu-154</td>
<td>834</td>
<td>648</td>
<td>78%</td>
<td>22.9</td>
</tr>
<tr>
<td>ATR 72</td>
<td>814</td>
<td>31</td>
<td>4%</td>
<td>19.6</td>
</tr>
</tbody>
</table>
Retirement regions

The aircraft were largely on an US registration at the moment of decommissioning.

Last operating country (1980-2015)

Top 20 countries/regions of retired aircraft (1980-2015)

<table>
<thead>
<tr>
<th>Country/Region</th>
<th># of Retired</th>
<th>Average Retirement Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>5,555</td>
<td>26.6</td>
</tr>
<tr>
<td>USSR/CIS</td>
<td>3,620</td>
<td>24.9</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>488</td>
<td>25.2</td>
</tr>
<tr>
<td>Indonesia</td>
<td>302</td>
<td>26.9</td>
</tr>
<tr>
<td>Canada</td>
<td>295</td>
<td>27.6</td>
</tr>
<tr>
<td>France</td>
<td>234</td>
<td>23.6</td>
</tr>
<tr>
<td>China</td>
<td>213</td>
<td>17.6</td>
</tr>
<tr>
<td>Mexico</td>
<td>194</td>
<td>33.7</td>
</tr>
<tr>
<td>Nigeria</td>
<td>190</td>
<td>29.1</td>
</tr>
<tr>
<td>Venezuela</td>
<td>173</td>
<td>31.8</td>
</tr>
<tr>
<td>Congo (Democratic Republic)</td>
<td>167</td>
<td>32.8</td>
</tr>
<tr>
<td>Ireland</td>
<td>164</td>
<td>25.2</td>
</tr>
<tr>
<td>South Africa</td>
<td>161</td>
<td>31.5</td>
</tr>
<tr>
<td>Brazil</td>
<td>161</td>
<td>30.2</td>
</tr>
<tr>
<td>Germany</td>
<td>151</td>
<td>23.7</td>
</tr>
<tr>
<td>Australia</td>
<td>144</td>
<td>24.9</td>
</tr>
<tr>
<td>Colombia</td>
<td>113</td>
<td>29.5</td>
</tr>
<tr>
<td>Spain</td>
<td>102</td>
<td>27.0</td>
</tr>
<tr>
<td>Philippines</td>
<td>99</td>
<td>30.8</td>
</tr>
<tr>
<td>Netherlands</td>
<td>93</td>
<td>22.5</td>
</tr>
</tbody>
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Major disassembly locations

Major disassembly areas are mainly situated in the southern parts of the USA.
Top 20 storage airport locations

More than 33% of the stored aircraft are located in the USA
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Economy and oil prices

Aircraft retirement trends are influenced by several macro economic factors.
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Introduction of new aircraft

Technical development is an important aircraft retirement driver

**737 family in service rate & total retirement (till 31/12/2015)**

- **737-100/200**
- **737CL**
- **737NG**

**A300 and A330 family in service rate & total retirement (till 31/12/2015)**

- **A300/A310**
- **A330**
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Components value and demand

Supply and demand in the component market also influence the retirement curve

Indicative breakdown of individual component values

Source: SGI Aviation proprietary databases
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Conclusion

- Over 15,000 aircraft retired in last 36 years
- Average retirement age around 27 years
- Freighter conversion adds about 10 to 20 years of life

- World growth and price of oil is one of the main drivers
- Geopolitical events and regulatory restrictions also heavily influence retirements

- Parts value is heavily dependent on actual condition
- Main value is in the engines
- Airframe has limited value and some structural parts are difficult to sell
Questions?

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