IATA & Aircraft Decommissioning

Chris Markou

IATA

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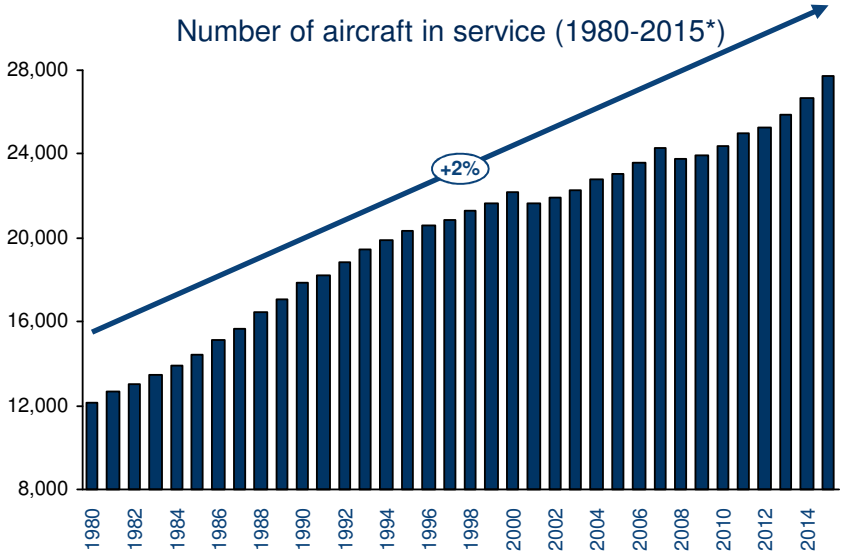
Agenda

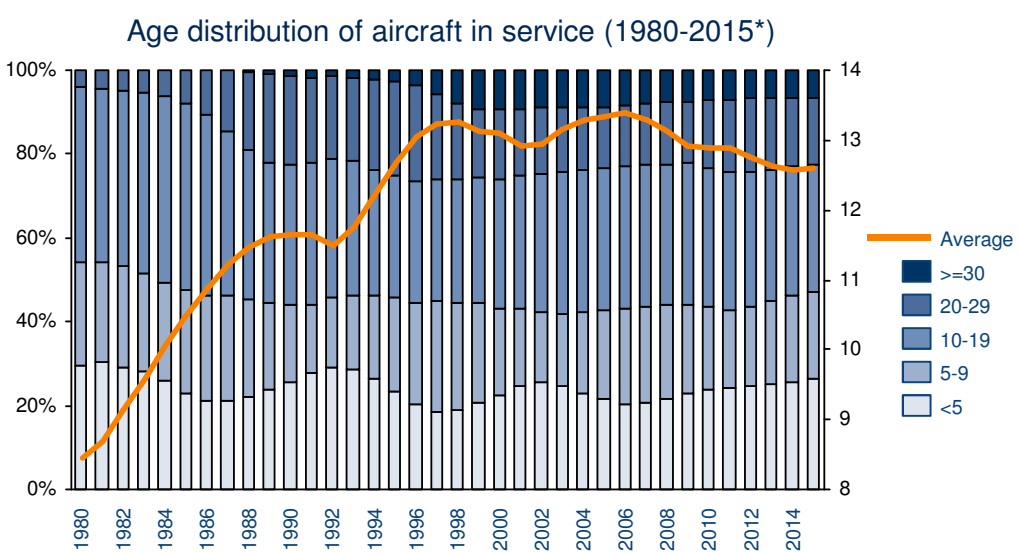
- Introduction
- Aircraft Retirements and Trends
- Aircraft Retirement Drivers
- Aircraft Storage and Part-out Markets
- Participants in Aircraft Decommissioning
- Recommendations

Thanks to SGI Aviation and AFRA for their contributions

Introduction

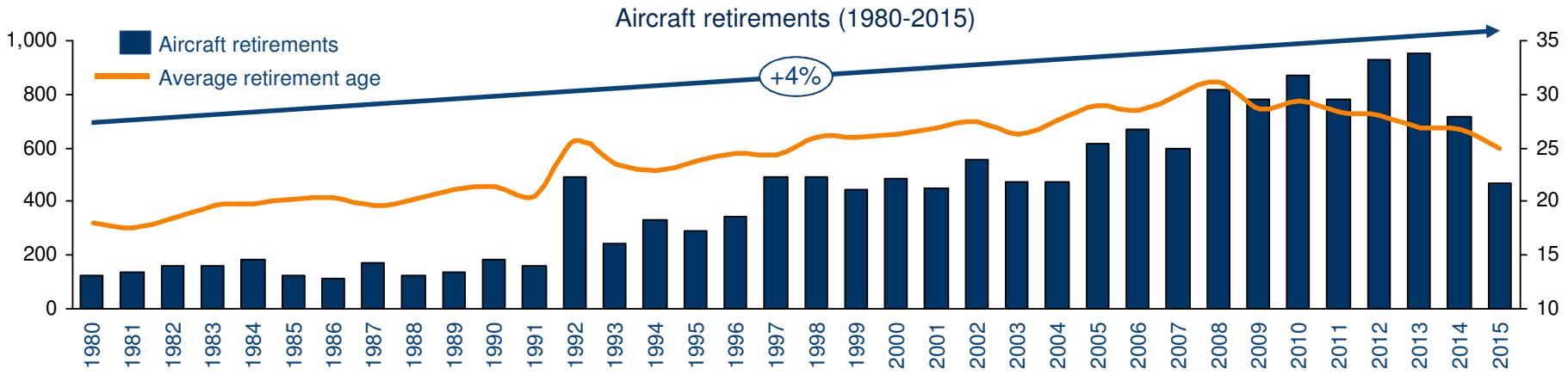
- More than 27,000 aircraft in service by the end of 2015;
- The average age of aircraft in service has been relatively stable in the last 15 years (small drop in last 6 years);
- Increasing amount of aircraft removed from service and subsequently decommissioned over the upcoming years



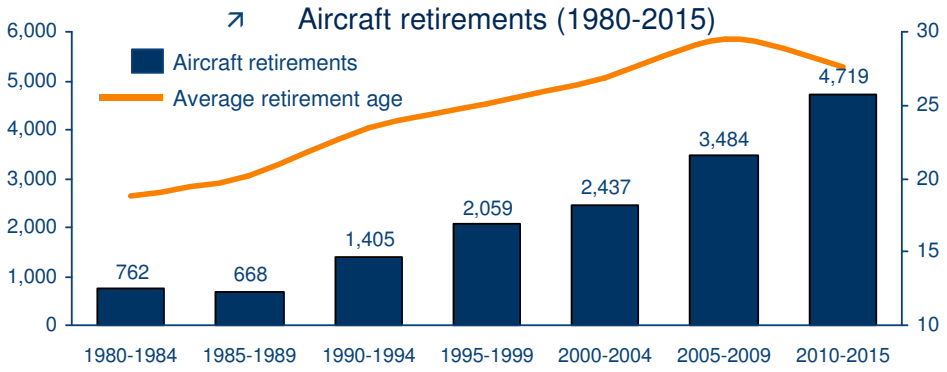


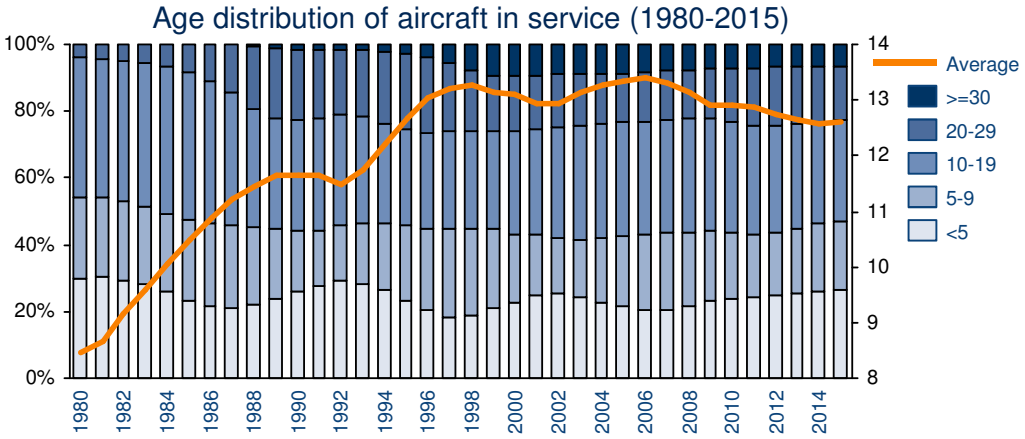
Aircraft retirements (1980-2015)

- More than 15,000 commercial AC retired worldwide so far; CAGR = 4%
- 700 - 900 aircraft retired annually (2008-2014); avg. age of around 27 years
- Large fluctuations in the number of retirements; linked to external influences
- Fluctuations provide a valuable in-sight in the retirement drivers
- Avg. aircraft age at retirement has decreased over the last 7 years.



Historical trend

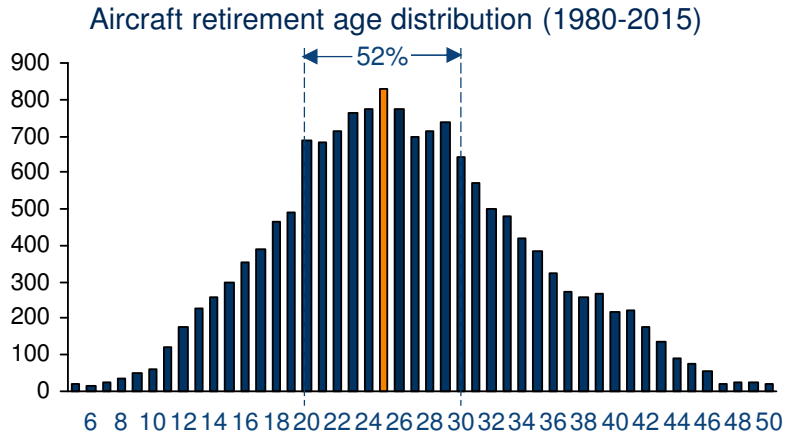


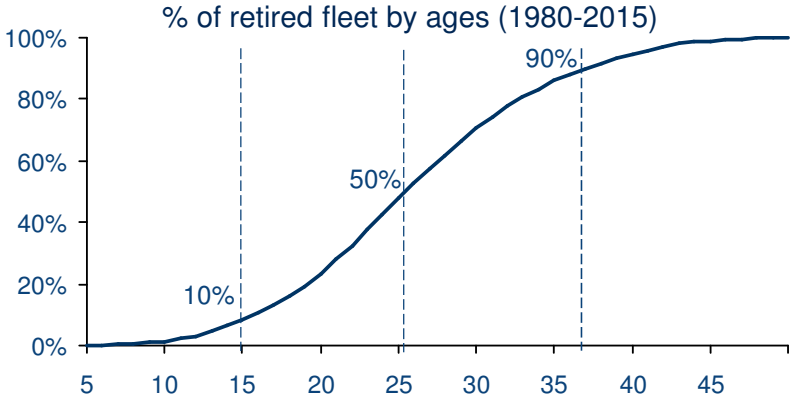


- Number of retirements has increased continuously over the last 36 years, in line with world fleet growth (except '85-'89)
- Avg. AC retirement age has increased from 18.8 yrs (1980-1984) to 29.4 yrs (2005-2009)
- Avg. age of commercial AC in service has slightly decreased in the recent 6 years (explained by an increase of production rates and AC being retired younger).

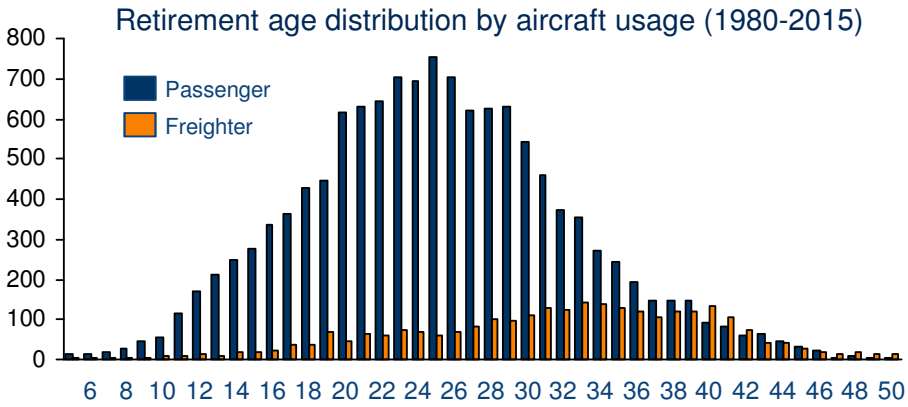
Retirement age distribution (1/3)

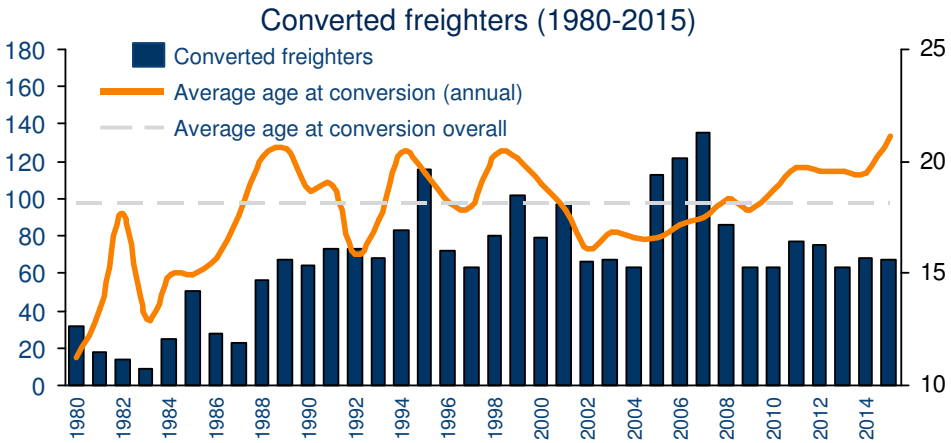
- Avg. retirement age for commercial AC over the last 36 years is 26.5 yrs
- More than half of the aircraft are retired between the age of 20 and 30 years
- About 10% of the aircraft were retired before the age of 17 years during the analysed term
- Another 10% of the aircraft went out of service after the age of 37 years





Retirement age distribution (2/3)





- Passenger aircraft account for 83% of the commercial aircraft retirements
- Significant differences between passenger and freighter aircraft retirement behaviours
- The freighter conversion extends the in-service time. Conversion takes place when the aircraft is 18 yrs adding 10-20 yrs extra life
- Lower utilisation of freighters leads to lower ops cost by extending the aircraft life cycle.

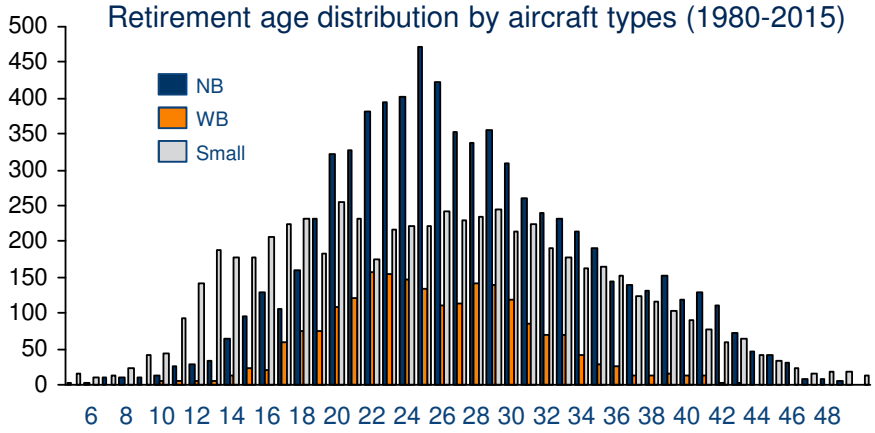
Retirement age distribution (3/3)

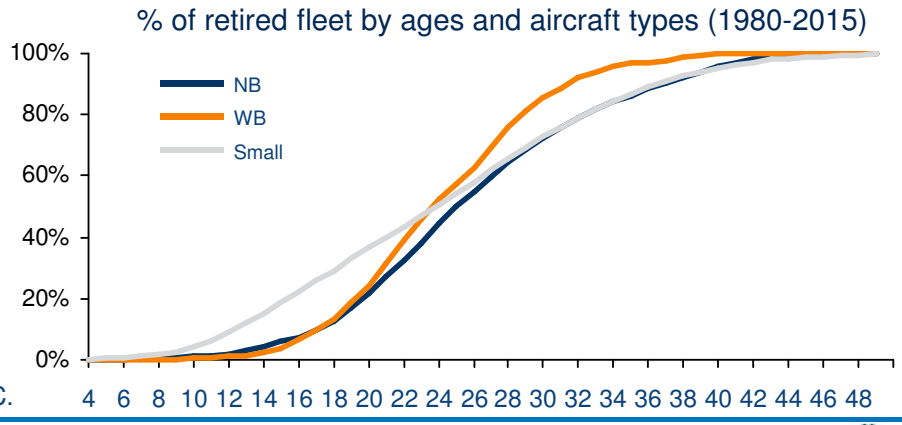
- Narrow body (NB) aircraft 47%...
- Small (SM)[1] aircraft 39% …
- Wide body (WB) aircraft 14%.

Average retirement age:

- NB aircraft around age 25…
- WB aircraft tend to have double retirement peaks at age 23 and 29…
- SM aircraft show retirement peaks between 15 - 20, and secondary peaks appear around age 26 (driven by Russian built aircraft)

Aircraft tend to be decommissioned right before expensive maintenance events

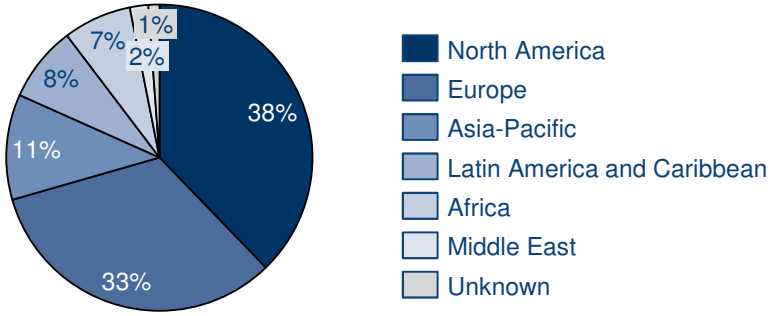




1. SM: less than 100 seats AC.

Retirement areas

Retirement areas[1] breakdown (1980-2015)



- Of all retired aircraft, 38% are retired in North America and 33% were retired in Europe (of which 63% in the former USSR[2] or current CIS[3])
- Aircraft retired from the top twenty countries/regions accounts for 78% of the total retired fleet.

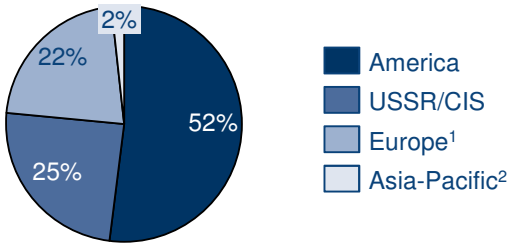
Top 20 countries/regions of retired aircraft (1980-2015)

Country/Region	# of Retired	Average Retirement Age
United States	5555	26.6
USSR/CIS	3620	24.9
United Kingdom	488	25.2
Indonesia	302	26.9
Canada	295	27.6
France	234	23.6
China	213	17.6
Mexico	194	33.7
Nigeria	190	29.1
Venezuela	173	31.8
Congo (Democratic Republic)	167	32.8
Ireland	164	25.2
South Africa	161	31.5
Brazil	161	30.2
Germany	151	23.7
Australia	144	24.9
Colombia	113	29.5
Spain	102	27.0
Philippines	99	30.8
Netherlands	93	22.5

1. Retirement areas are represented by the last operating country.
2. USSR = Union of Soviet Socialist Republics.
3. CIS = Commonwealth of Independent States, including Russia, Ukraine, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Uzbekistan and Turkmenistan.

Retired types of aircraft (1/2)

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



- Aircraft manufactured in America make up the largest portion of retired aircraft (52%)
- USSR/CIS produced aircraft form the second largest retirement share of 25%
- Aircraft types for which the largest portion has been retired (e.g. 727, 737-100/-200 and An-24) will not be the main retirement focus
- Types which are at sunset of the life cycle (e.g. 747, 737 CL, MD-80) will dominate the short-term dynamics in the market.

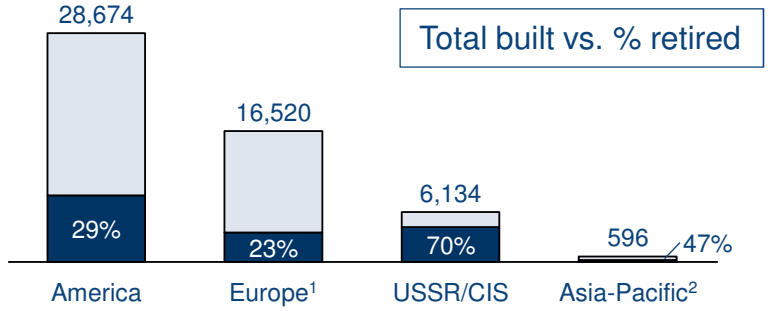
Top 20 aircraft retired (till 31/12/2015)

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

1,2. In this context, Europe and Asia-Pacific exclude USSR and CIS countries.

Retired types of aircraft (2/2)

Retirement rate by manufacturer's locations (end 2015)



- 70% of USSR/CIS built aircraft are already retired, whilst more than 70% of American and European built aircraft are still in active service
- The combination of a large number of aircraft produced, a low retirement rate so far and the introduction of the follow-up models will drive a retirement wave in the long-term future for: 737 NG, A320 family, 777 and A330

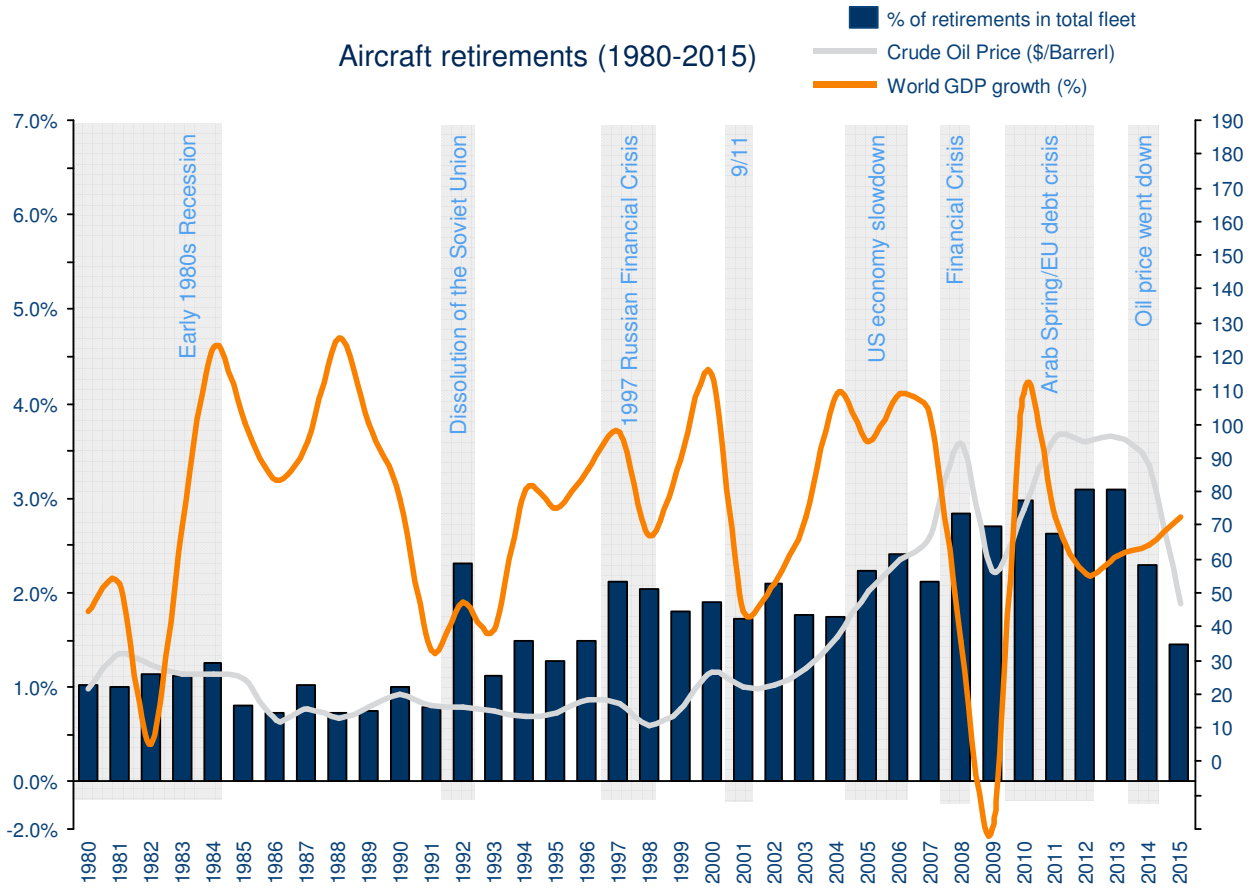
Top 20 aircraft delivered (till 31/12/2015)

Aircraft Type	# of Delivered	# of Retired	Retirement rate	Average retirement age
737 NG	5478	54	1%	12.6
A320	4115	266	6%	20.1
737 CL	1979	670	34%	22.7
727	1775	1492	84%	31.4
747	1492	714	48%	27.1
A319	1382	23	2%	14.0
777	1355	20	1%	16.8
A330	1222	21	2%	16.9
A321	1210	18	1%	19.1
MD-80	1190	490	41%	24.0
Dash 8	1123	69	6%	17.9
An-24	1100	760	69%	30.3
737-100/-200	1078	810	75%	30.3
767	1064	160	15%	24.5
757	1039	101	10%	24.3
CRJ Regional Jet	1021	146	14%	14.2
Yak-40	942	629	67%	25.9
DC-9	931	725	78%	35.2
Tu-154	834	648	78%	22.9
ATR 72	814	31	4%	19.6

1,2. In this context, Europe and Asia-Pacific exclude USSR and CIS countries.

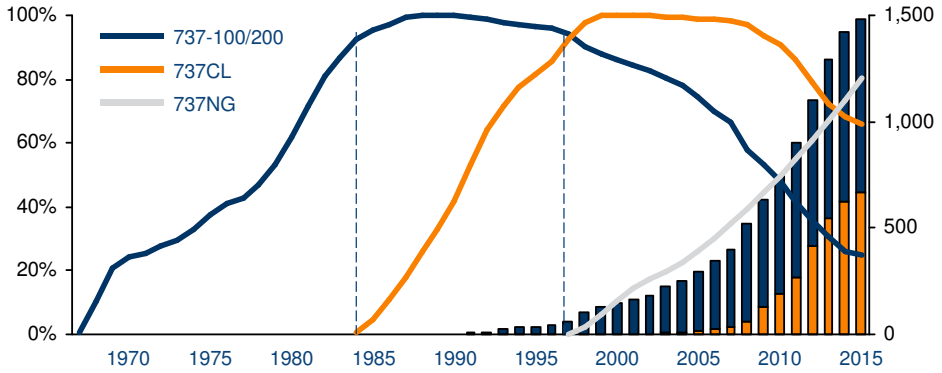
Economy and oil prices

- Airline bankruptcies correlate with the variation of GDP and Oil prices
- Although these factors do not exclusively influence the retirement trends, their effect is noticeable
- Oil prices is a main driver for aircraft retirements.

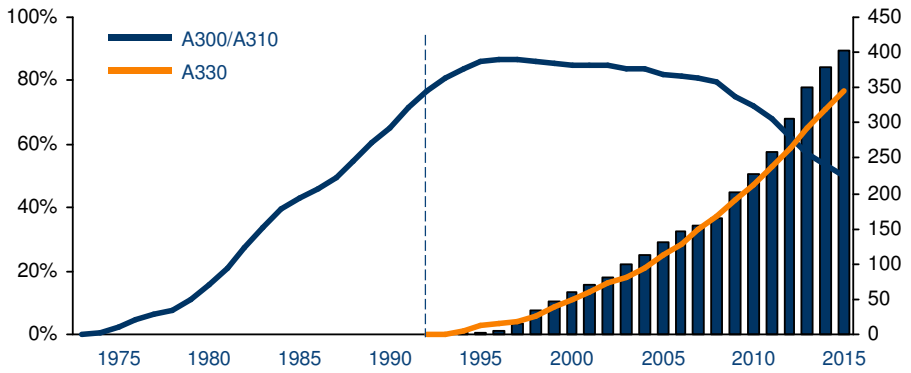


Introduction of new aircraft

737 family in service rate & total retirement



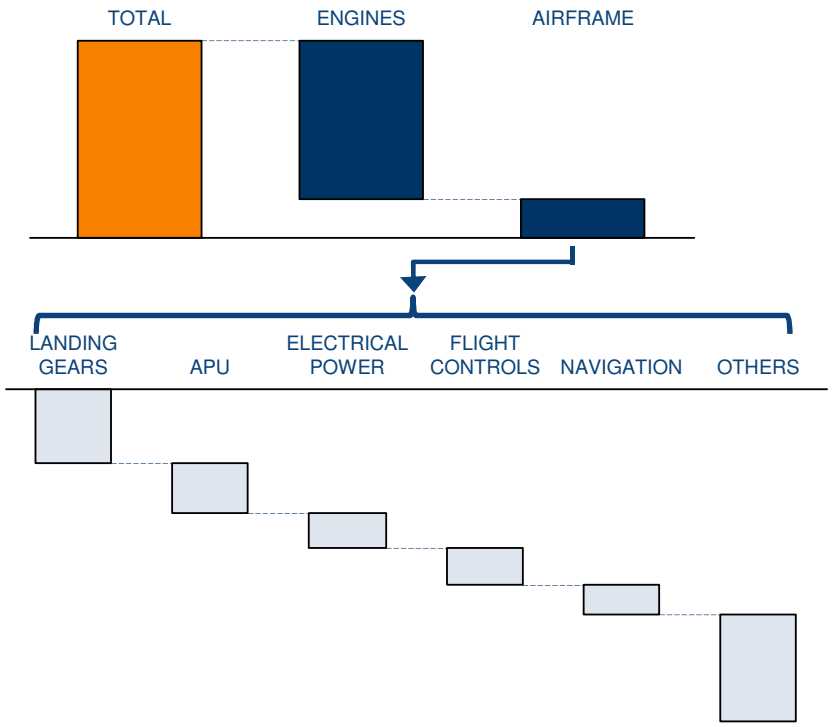
A300 and A330 in service rate & total retirement



- Production levels for 737-100/200 aircraft levelled off in 20 yrs. Just before the peak, the following-up aircraft type, the 737CL was introduced;
- The same decreasing effect on the 737CL in service levels can be observed after introduction of the 737NG. Additionally, the introduction of the sub-sequential aircraft model occurs at a faster pace than its predecessors and the steep decrease of the 737CL in service level is measured earlier;
- The same effect on the Airbus A300 can be seen after the introduction of the Airbus A330. Right after the introduction of the A330 aircraft the A300 in service levels started to decrease.

Components value and demand

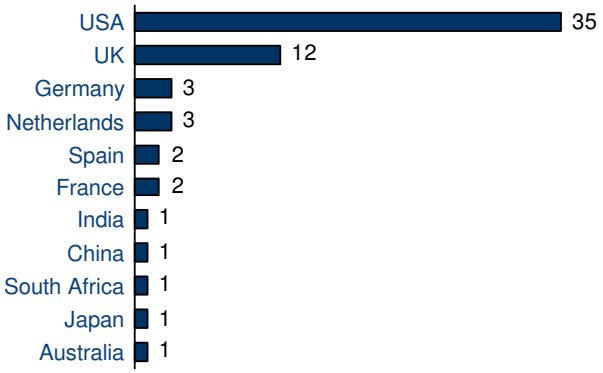
Value breakdown of a part-out candidate aircraft



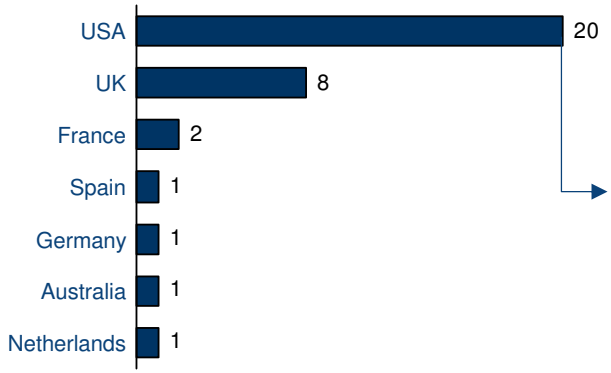
- The residual value of the aircraft is the sum of the value of its individual components minus the cost to decommission it.
- Engines account for 80% of the residual value. The engine condition and the standard of high cost parts affect the value.
- Top five components: landing gear, APU, generators, flight controls and navigation systems make up of about 20%;
- Other influencing factors are: regulatory environment, compulsory upgrades and existing airworthiness directives;
- Content of components with high value and high demand could also favor the retirement of an aircraft.

Geographical diversification and facilities

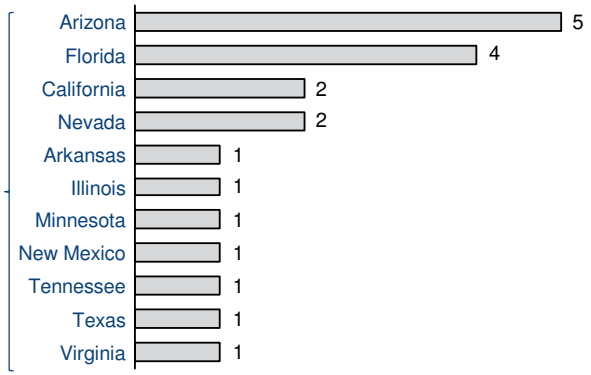
Total (total 62)



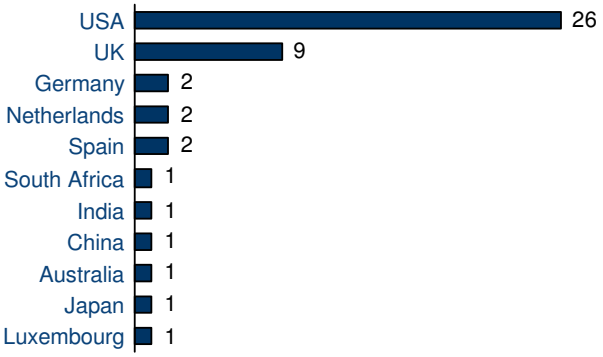
Disassembly facilities (total 34)



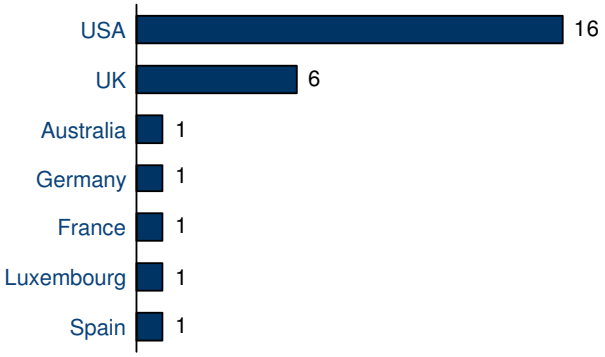
Disassembly facilities in the USA (total 20)



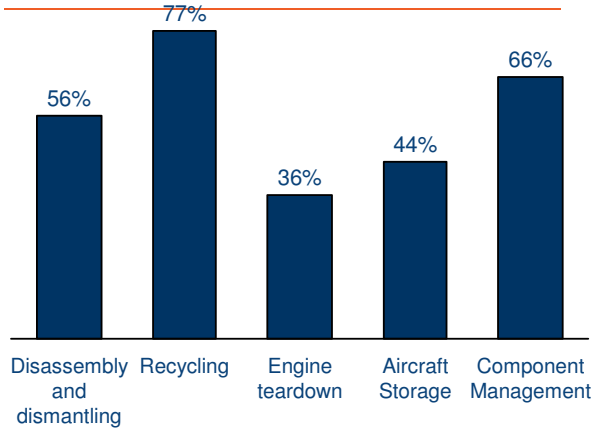
Recycling Facilities (total 47)



Storage Facilities (total 27)

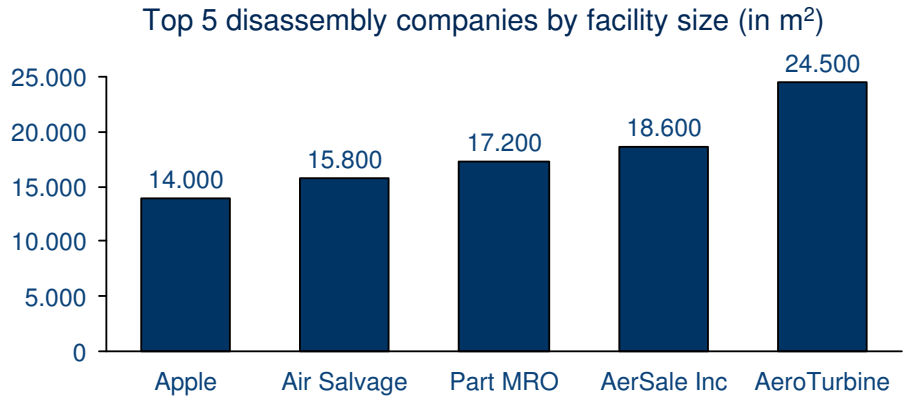


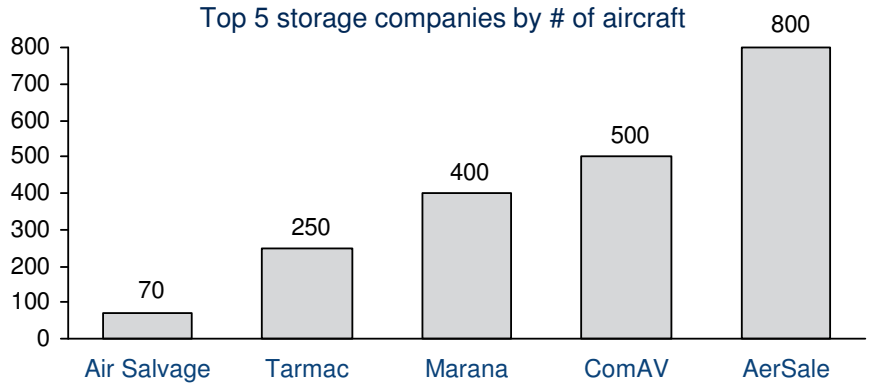
Sub-division measured activities (total 62)



Geographical diversification and facilities

- ↗ The largest share of storage and disassembly locations are situated in southern US (dry conditions to avoid corrosion; e.g. Arizona)
- ↗ Deserted airports are commonly (re)used as storage and disassembly location; low parking fees, sufficient space available
- ↗ Many of these companies provide services that allow aircraft owners to disassemble the aircraft at their location
- ↗ Main European locations are situated in the UK and France. No known major sites in the South-East Asia region.
- ▪ The largest disassembly company are AeroTurbine (AerCap) and AerSale.

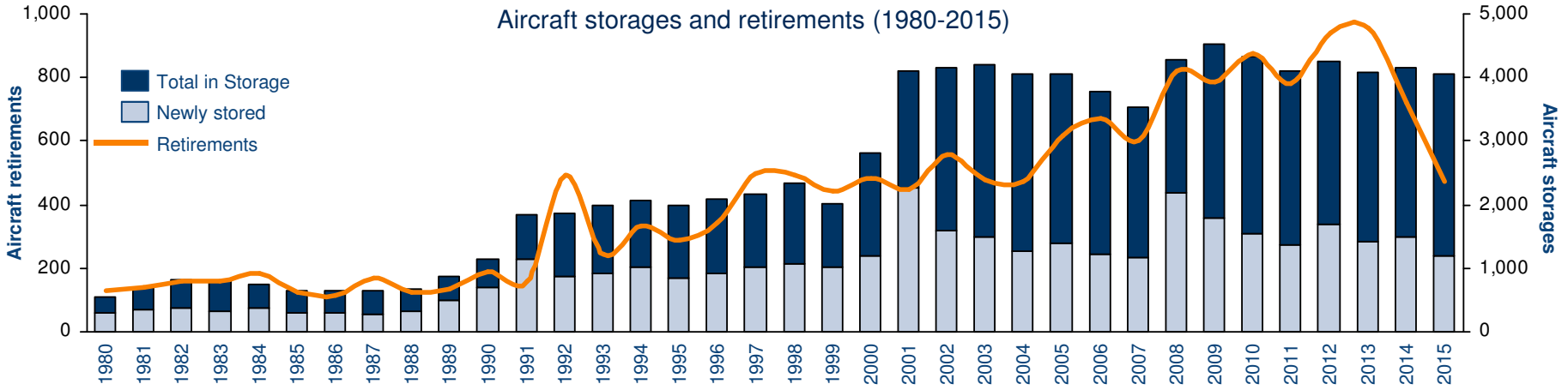




Major disassembly airport locations

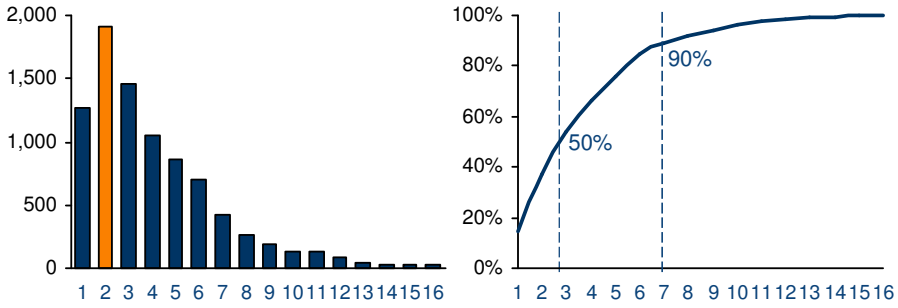
Storage trends

- From 1980 to 2015, more than 24,000 aircraft have been registered as stored;
- Since 2001, the total number of commercial aircraft in storage has been approximately 4,000; the number of newly stored aircraft is around 1,500 annually. More than 2,000 aircraft went into storage between 2001 and 2008 respectively because of 9/11 and the financial crisis;
- More aircraft are put into storage than retirement each year;
- Storage trends consistent with retirement; storage wave is 1 year ahead of that of retirement;
- By end of 2015, 4,058 aircraft in storage; avg age of 24.8 and avg in storage time of 3 yrs.

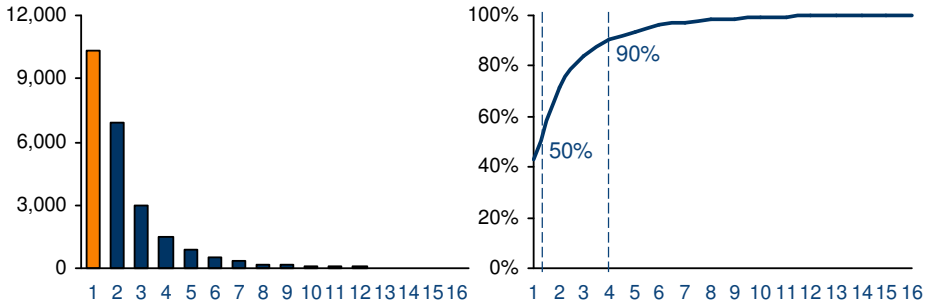


Retirement & return to service after storage

Storage time (in years)[1] before retirement



Storage time (in years) before return to service[2]



- From 1980 to 2015 more than 9,000 aircraft, equal to 38% of all stored aircraft, have been retired. This represents a 58% share of the total aircraft retirements (compared with direct retirement from service);

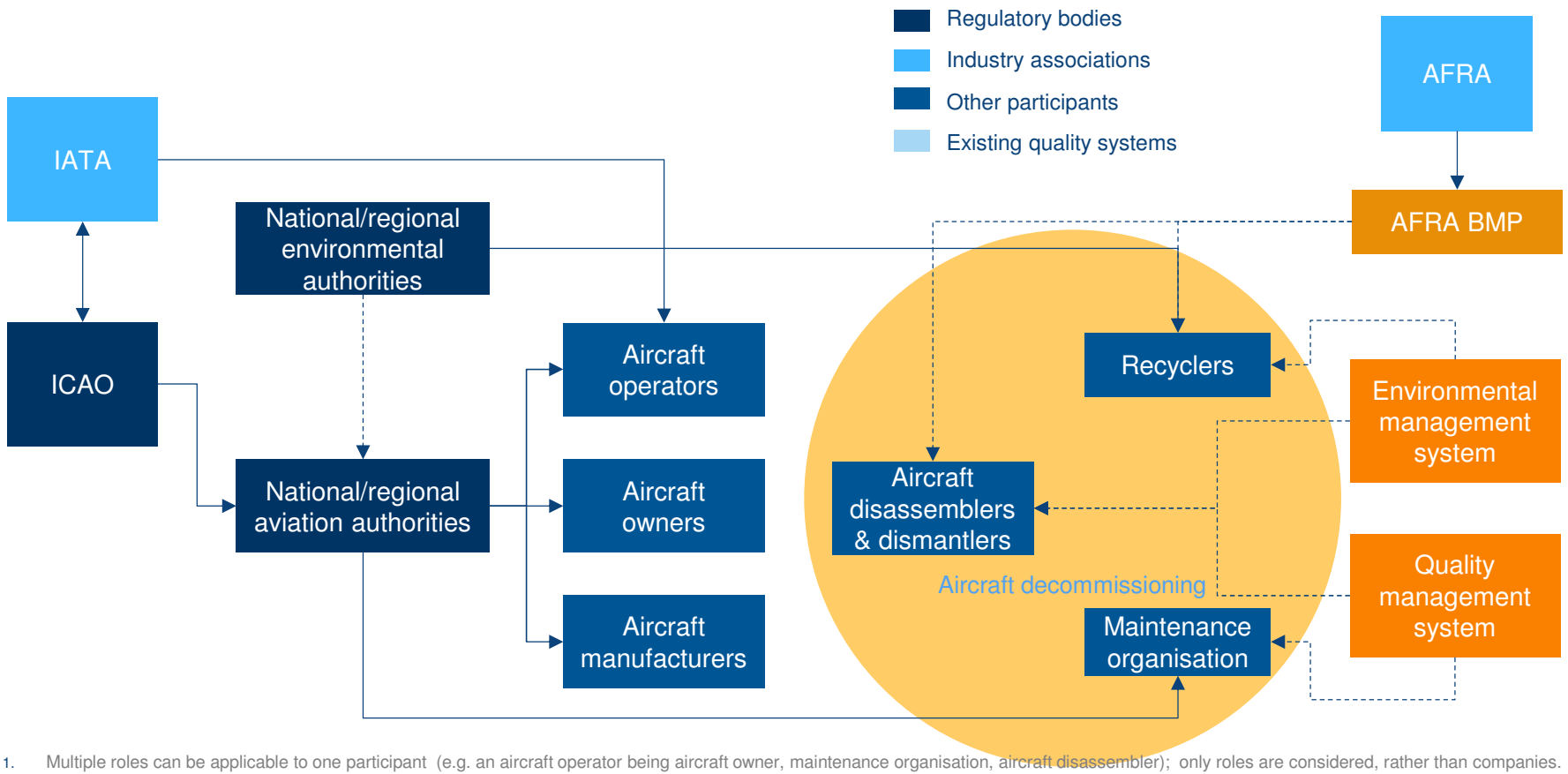
- Some 16,000 aircraft in storage have returned to service at least once (66% of AC from 1980 to 2015);
- 63% has re-entered service once; 26% has entered service twice;
- More than 70% of return-to-service occurred within 2 years after entry.

1. For aircraft which have entered storage more than once, only the last storage time has been considered.
2. No accurate date of return to service is provided by the database, it is assumed that every aircraft returned to service in the middle of a year.

Future trends

- The combination of a large number of aircraft produced, a low retirement rate so far and the introduction of the follow-up models will drive a retirement wave for aircraft such as 737 NG, A320 family, 777 and A330;
- New aircraft models with improved technology drive retirement;
- Aircraft retirement in the coming years will highly depend on macro-economy and oil prices;
- No known major disassembly and storage locations situated in the high growth South-East Asia region.

Participants[1] in aircraft decommissioning



1. Multiple roles can be applicable to one participant (e.g. an aircraft operator being aircraft owner, maintenance organisation, aircraft disassembler); only roles are considered, rather than companies.

Existing oversight systems

AFRA BMP

- AFRA offers accreditation to companies complying with the BMP;
- The BMP provides the guidance for facility, training, documentation & records, tooling, parts and material management during processing, environmental protection and accountability to the customer;
- About half of AFRA members (31) are accredited by AFRA.

Environmental mgt systems

- Several recognised environmental management systems (EMS) including the IEnvA program. Mostly based on the ISO 14001;
- About 22% of companies in the global aviation industry have obtained ISO 14001 certification;
- Very few disassembly, dismantling and recycling companies hold this certification to prove their environmental management.

Quality mgt systems

- QMS ISO 9001;
- AS9100 and ASA-100 are two QMSs, based on ISO 9001 and developed for aviation;
- A few aircraft dismantling and recycling companies are ISO 9001 accredited. Part certifiers tend to choose AS9100 and ASA-100 in place to make sure of the quality of aircraft.

Summary of Analysis[1]

I. Decision to decommission an aircraft

Aircraft operators	Aircraft owners	Part-out companies
Fleet planning	Market	
Maintenance cycles		
Government restrictions	Aircraft value	
Incident/accident		
Tax regulations		
		Other regulations
Current generation vs old generation aircraft		
Engines		

II. Selection of facilities

Aircraft operators	Aircraft owners
Costs	
Location and climate	
Capability and credibility	
Saleability of parts	
Protection of ownership rights	
Environmental protection	
AFRA accreditation	
No storage preferred	
Operational shift	Beforehand exit scenario
	Market condition
	Aircraft value

III. Disassembly and dismantling process

Part-out companies
General environmental regulations
Health and safety regulations
Parts recertifying and distribution regulations
AFRA procedures
Risk of fuel and oils removal and disposal
Others risks
Regulations on storage conditions
Insight of disassembly of new aircraft

IV. Parts distribution and recertification

Part-out companies
High value components
Reliability of parts
Market supply and demand
Mandatory technical changes
OEM policies
Parts value risk
Acceptance risk of parts
Reliability risk of parts
Parts database
Bilateral agreements

1. Multiple roles can be applicable to one participant (e.g. an aircraft operator being aircraft owner, maintenance organisation, aircraft disassembler); only roles are considered, rather than companies.

Recommendations (1)

- For operators:
  - Workshops and guidance materials to improve the procedures and benefits of decommissioning;
  - Establishing best practices for operators guiding them in selecting best moment for retirement and keeping good residual value
- For decommissioning facilities:
  - Explicit guidance on how to handle hazardous materials (e.g. fuel and oils), new materials (e.g. carbon fibers) and parts used on aircraft.

Recommendations (2)

- Affecting the interaction between governments and industry:
  - Explore usage of the Incident Clearance Statement (ICS) that has a high impact on the value of a part;
  - Expand acceptance level of parts removed from a disassembled aircraft;
  - Create more uniformity within major aviation regulatory regimes to allow acceptance of foreign release certificates;
  - Develop an accurate and comprehensive database of the actual aircraft status to trace aircraft and parts movements.
  - Research the feasibility of a Certificate of Retirement (or equivalent);
  - Compare regulations of import tax and sales tax on aircraft and components in different countries to provide a valuable in-sight of these practices and aircraft movements.

Thank You!

Any Questions?