Green Aviation – A Paradigm shift from Quantitative to Qualitative Growth

Volker Gollnick

German Aerospace Center
Institute for Air Transportation Systems

Greener Skies Ahead
3rd December 2013
Cologne
Outline

- Next 30 Years in Aviation
- Aircraft Technologies from Operational Perspective
  - Laminar Flow Technology
  - Change Operational Flight Profiles
  - Modifications in Weight and Fuel
- Summary
Aviation induced contrails become a major issue of climate impact

Aviation operations are more relevant!
Next 30 Years in Aviation

Envisaged growth of aviation of about 5% is related to increasing passenger movements
Next 30 Years in Aviation

A/C movements vs. available seat miles at Lufthansa

Development of passenger per flight

Trend towards larger aircraft and more passenger per flight

Better climate and transport efficiency
Airlines tend to operate nearly constant fleets with increasing seat capacity except Asian airlines.
Next 30 Years in Aviation

All Aircraft of the next 25 years are fixed and known
Next 30 Years in Aviation

Business Driver in Aviation

- **Stakeholder**
  - Airline
  - Airport
  - Air Navigation Services
  - Aircraft Manufacturer

- **Revenue Source**
  - Passenger
  - Airline fees
  - Aircraft sale

**Passenger and fees** drive revenue for all system stakeholder

**Energy, staff** cost most relevant for all system stakeholder
Next 30 Years in Aviation

- People’s mobility does not necessarily require more aircraft
- Contrails seem to be as relevant as CO₂ emissions for Green Aviation
- Energy cost will drive the business
- No window of opportunity for aircraft configuration technologies until 2035
- After sales services become an interesting market
- Product life cycle improvements
  - New cabin interiors
  - Software updates and upgrades
  - Minor modifications
  - Maintenance Repair Overhaul
- Operational Improvements crucial for sustainable Green Aviation

Make money with qualitative improvements during life cycle of a constant and existing fleet and more passenger

Paradigm shift from quantitative air transport growth to qualitative air transport growth
Aircraft Technologies from Operational Perspective
# Aircraft Technologies from Operational Perspective

## Laminar Flow Technology

### Questions of Interest

- **Is there a real benefit for operators?**
  - Realistic operational scenarios
  - Fuel saving on aircraft and fleet level
  - Economic effects
  - Operational boundary conditions

### Tool Chain

- **Single flight analysis**
  - Reference aircraft

- **Real route analysis**
  - Real airline network and frequencies

- **Network model and analysis**
  - Simulation of reference and LamAiR aircraft in a generic realistic airline network

- **Economic analysis**
  - Airline Life Cycle Cost analysis
  - Variation of: MRO cost, A/C price, fuel price, leg length

### Results

- Break-even mission range
- Fuel savings on fleet level
- Break-even fuel price
Aircraft Technologies from Operational Perspective

Laminar Flow Technology

Theoretical potential of nearly 8% on aircraft level

75% of all short range flights below 2000 km

Analysis performed on real airline network

Fuel saving from operational perspective

On real airline fleet level **fuel savings less than those by wing lets**

Net Present Value decreasing
Aircraft Technologies from Operational Perspective

Change operational flight profiles

Identification of **reduced climate** impact by

- lower flight altitudes and
- reduced cruise speeds

**World fleet** of a representative **long range aircraft**

Real flight trajectories used as reference for assessment

**Average Temperature Response** (ATR) and **Direct Operating Costs** (DOC) used as metrics

**Cost-Benefit-Assessment** of ATR and DOC change relatively to actual flight profiles
Aircraft Technologies from Operational Perspective

Change operational flight profiles

Reduced climate impact through lower flight profiles

Climate impact of global A330-200 fleet

5% DOC increase due to higher fuel consumption with less climate impact results in 31% temperature raise damping!

Based on:
- Global route network
- All A332 flights in 2006
- 2006 fuel and labour price levels
- 32 years sustained emission

Aircraft Technologies from Operational Perspective

Change operational flight profiles

22% temperature raise damping remain at 300% fuel price raise

Cruise speed selection depends on constant utilization

ATR reduction only possible if no additional aircraft movements, but larger aircraft possible
Aircraft Technologies from Operational Perspective

Modifications in weight and fuel

Light weight and compact seats: increase capacity (+12/150) and reduce weight (-30%/seat)
Resulting in 130,000kg fuel saving per year and aircraft

Use of Hydrotreated Vegetable Oil (HVO) leads to 1.87% (50/50) - 3% (100%) fuel savings at max payload, which is closer to real operations than max. range flights
Summary

- **Contrails** become as **relevant** as CO₂ for aviation climate impact
- **No** potential for **new** green **aircraft** until 2035
- **Laminar** technology **no option** from operational point of view
- **In service technologies** allow for greener operations
  - Flying slower and lower
  - Reduce cabin weight
- **Bigger aircraft** improve climate efficiency

Improve quality instead increasing quantity!
Thanks for listening!
Location

Channel Hamburg (Harburg)

Univ. Prof. Dr.-Ing. Volker Gollnick
Phone: +49 (0)40 42878-4197
Fax: +49 (0)40 42878-2979
Room: R06
E-Mail: volker.gollnick@dlr.de
Address: German Aerospace Center (DLR)
Institute for Air Transportation Systems at TUHH
Blohmstraße 18
D-21079 Hamburg