



# OPENAIR

OPTimisation for low Environmental Noise impact AIRcraft

Eugène Kors (Snecma)





## Agenda

- Project introduction
- Technologies
- Test facilities
- Technology Evaluation
- Sample of preliminary results



Project Coordinator : Snecma

No. Of Partners : 47

Objectives :

- **2,5 dB Noise reduction per operation**
- **Validation of Generation 2 Noise Technologies up to TRL5**
- **Integration and trade-off studies.**
- **Identification of applicability over the product range**

Project Duration : 4 years **(2009-2013)**

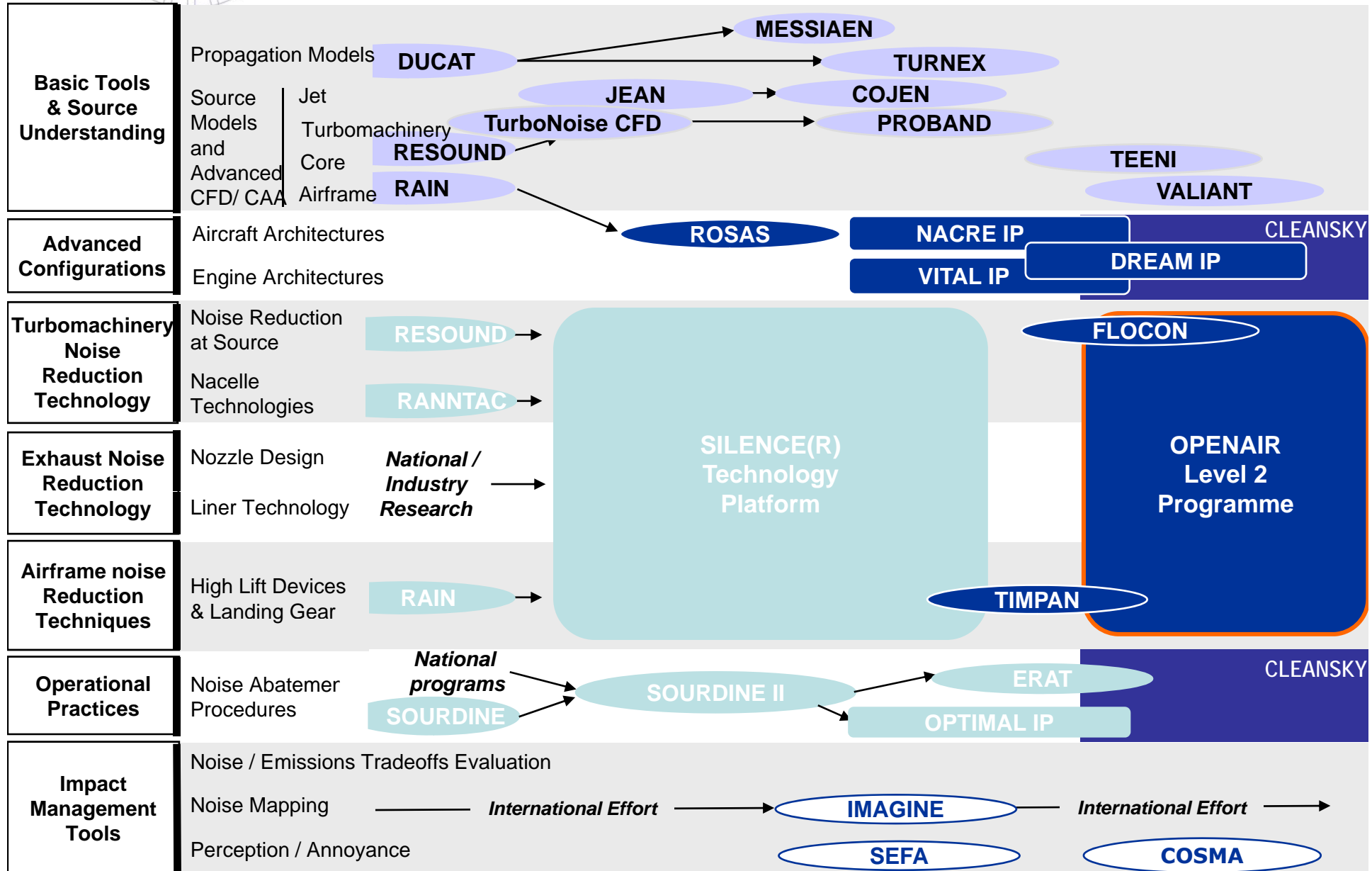
Total Budget: 30 M€



# Aircraft Noise Projects Roadmap

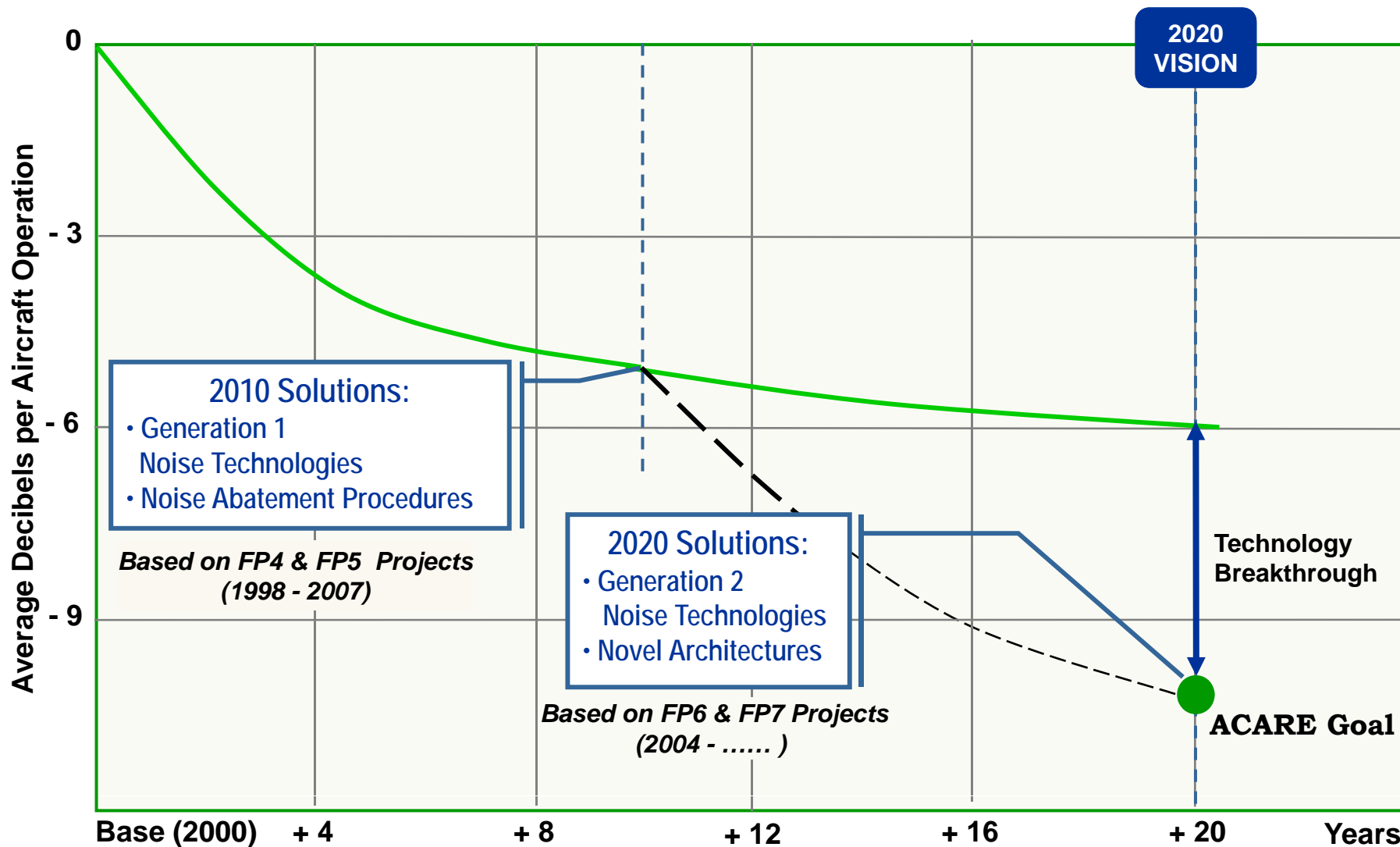


Years → 00 01 02 03 04 05 06 07 08 09 10 11 12





## Noise Reduction Objectives & Technology Paths: ACARE Vision





# OPENAIR Partnership

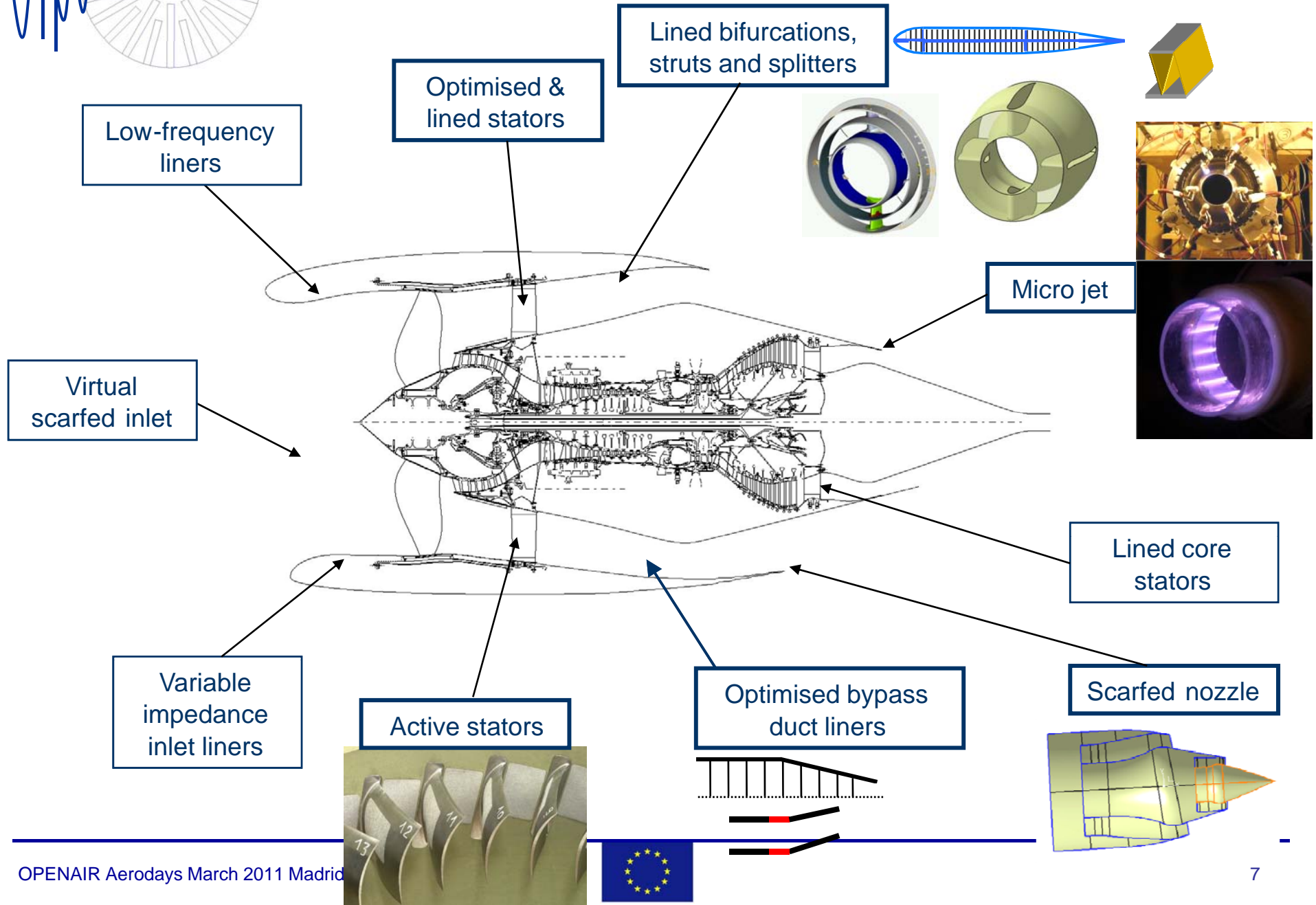
- 47 partners:
  - 20 Industries
  - 21 Research Institutes
  - 6 SMEs
- 15 countries
  - 12 EU states
  - 3 non-EU states (Swiss, Russia & Egypt)

<u>Industry</u>	
AEROSTAR	FR
Airbus Deutschland	DE
Airbus France	FR
Airbus UK	UK
Aircelle	FR
ATMOSTAT	FR
Avio	IT
Bombardier	UK
Dassault	FR
EADS	DE
GKN Aerospace	UK
ITP	ES
Messier-Dowty	FR
PFW Aerospace	DE
QinetiQ	UK
Rolls-Royce DE	DE
Rolls-Royce UK	UK
Snecma	FR
Snecma Propulsion Solide	FR
Volvo Aero	SE

<u>Research Institutes</u>	
Andreev Acous. Inst.	RU
ASU Cairo	EG
CEPr	FR
Chalmers	SE
CIRA	IT
CNRS	FR
COMOTI	RO
DLR	DE
EPFL	CH
Imperial College London	UK
IVTAN	RU
KTH Stocholm	SE
NLR	NL
ONERA	FR
Tsagi	RU
Univ. of Patras	GR
Univ. of Madrid	ES
Univ. of Roma Tre	IT
Univ. of Southampton	UK
Univ. of Cambridge	UK
VTT	FI

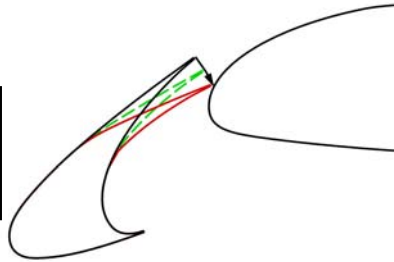
<u>SME</u>	
INASCO	GR
ARTTIC	FR
NASTECH	IT
CTTM	FR
FFT	BE
Microtech	PL



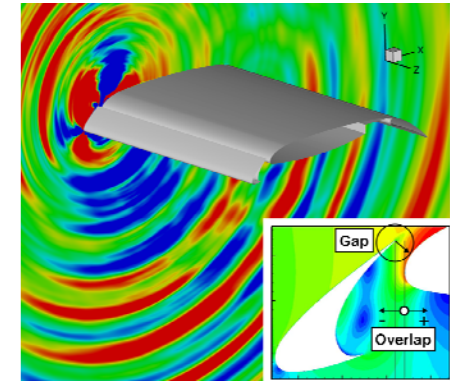




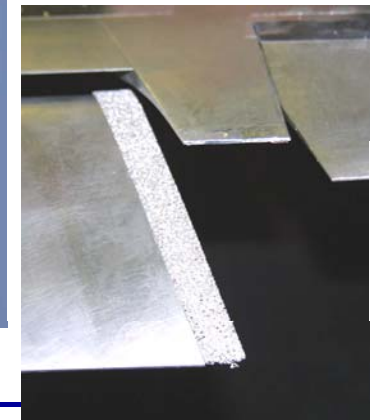
**Adaptive  
Slat gap**



**Optimised  
Slat settings**



**Flap side edge  
treatment**

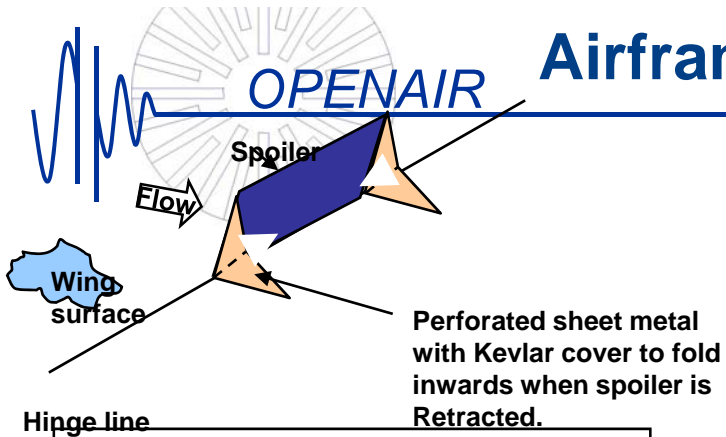


**Low noise LG  
design**

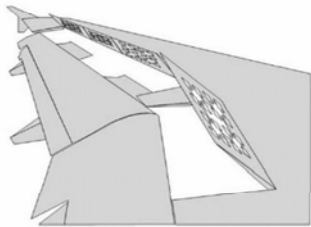




# Airframe noise: Innovative concepts

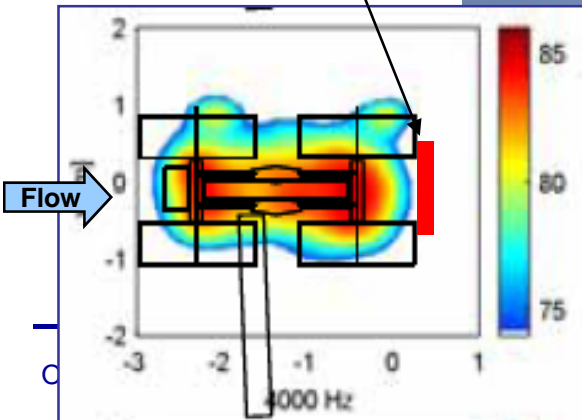


**Spoiler with folding fences**

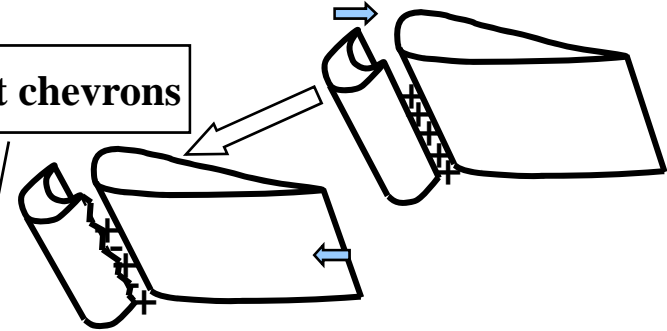


**Fractal spoiler**

**Downstream body**

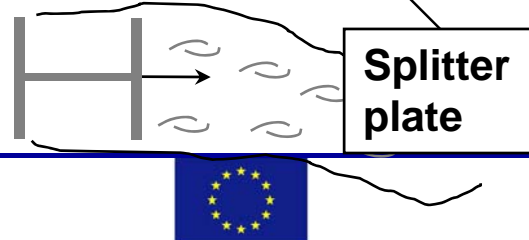


**Slat chevrons**

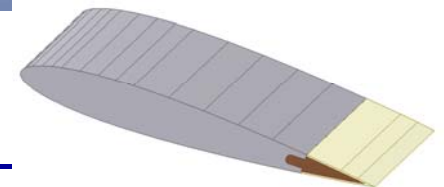


**Perforated trailing edge**

**Splitter plate**



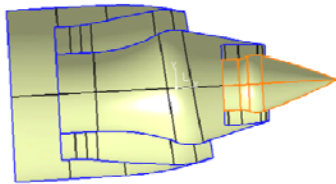
**Porous material**





## Main Test Facilities

- QQ NTF Noise Test Facility

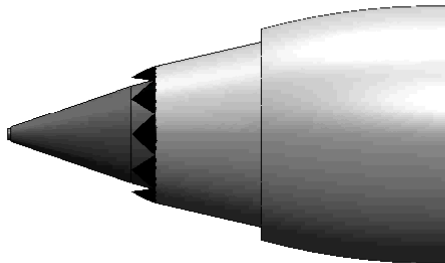






# Main Test Facilities

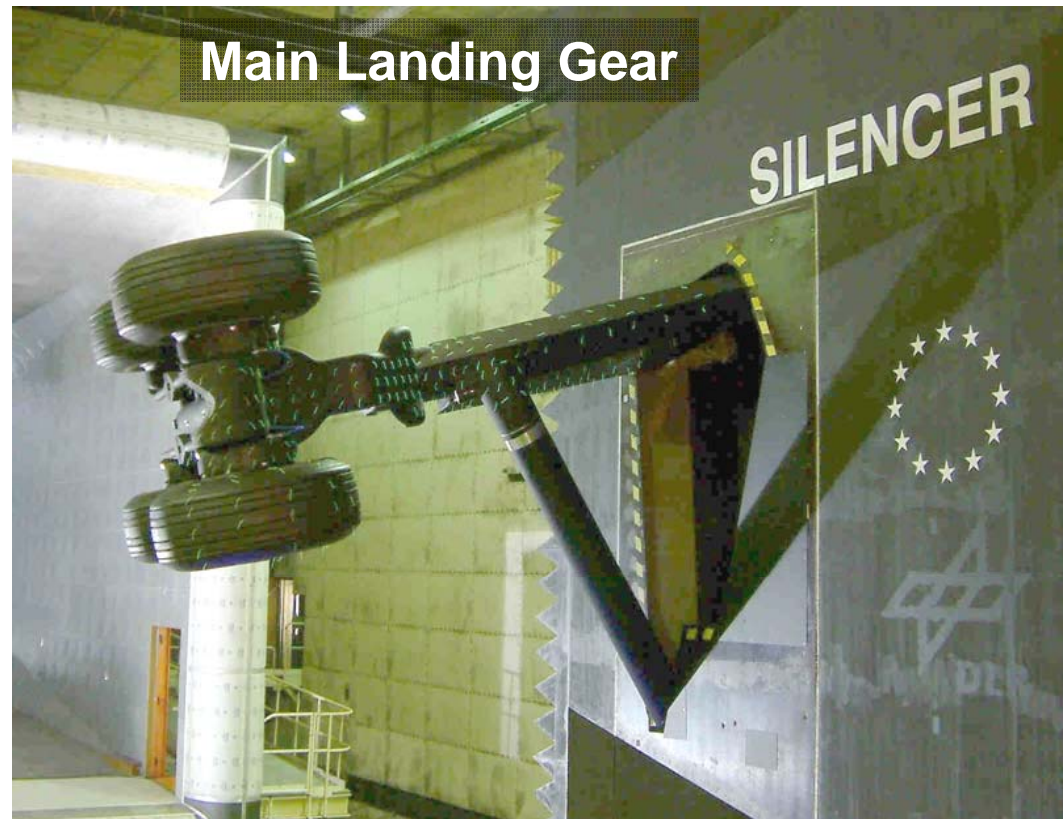
- ATA CEPRA19 Exhaust rig





## Main Test Facilities

- DNW LLF Large Low Speed Facility

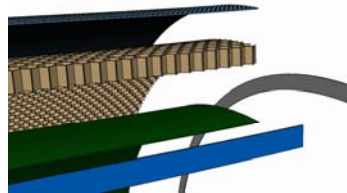






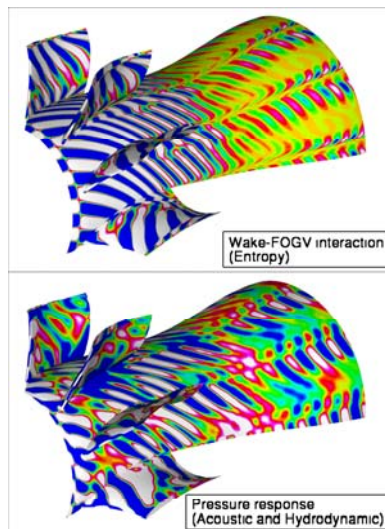
# Main Test Facilities

- AneCom UFFA/MFR Troubadix Fan rig



BOMBARDIER

- Duct liners



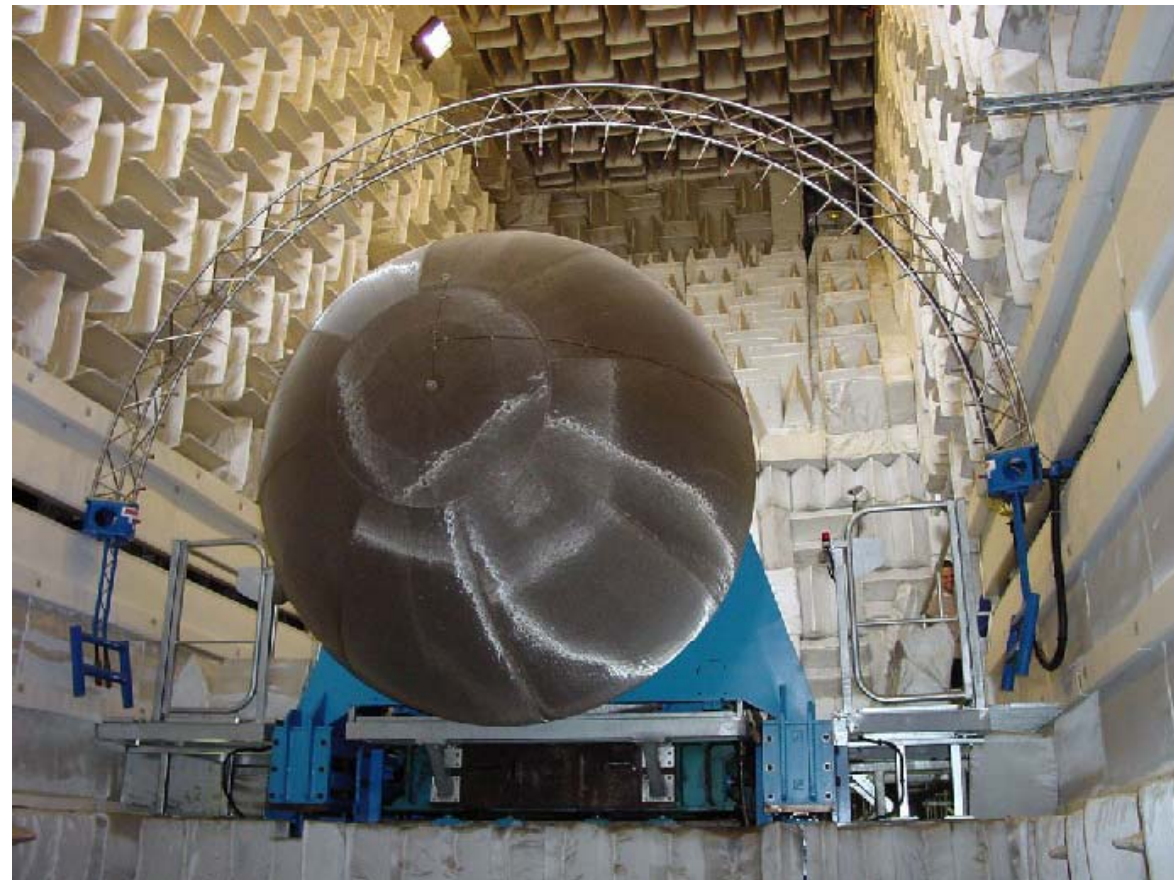
- Outlet Guide Vans





# Main Test Facilities

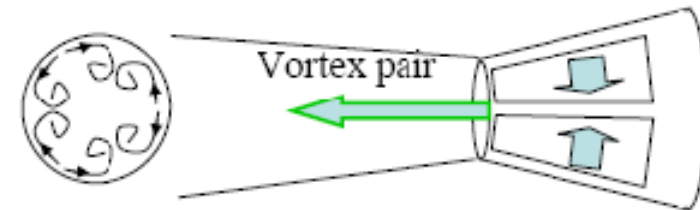
- RACE Fan rig





## Jet Noise reduction

- **Dielectrical Barrier Discharge (DBD) on the inner surface of nozzle:** creation of longitudinal vortex pairs for mixing control and noise reduction



Capralon nozzle with plasma actuators in TsAGI anechoic chamber

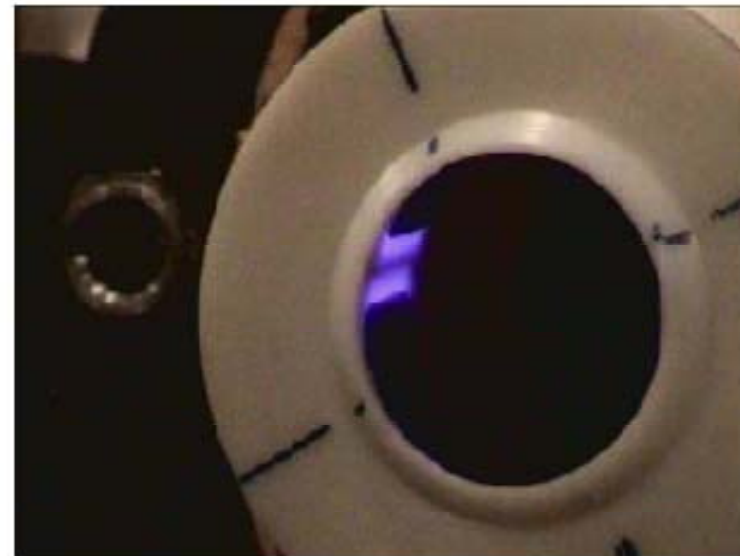
*V. Kopiev et all – International Workshop  
on Magneto-Plasma Aerodynamics 2010*



Central Aerohydrodynamic Institute  
(TsAGI) [www.tsagi.ru](http://www.tsagi.ru)



Joint Institute for High Temperatur  
(IVTAN) [www.ihed.ras.ru](http://www.ihed.ras.ru)

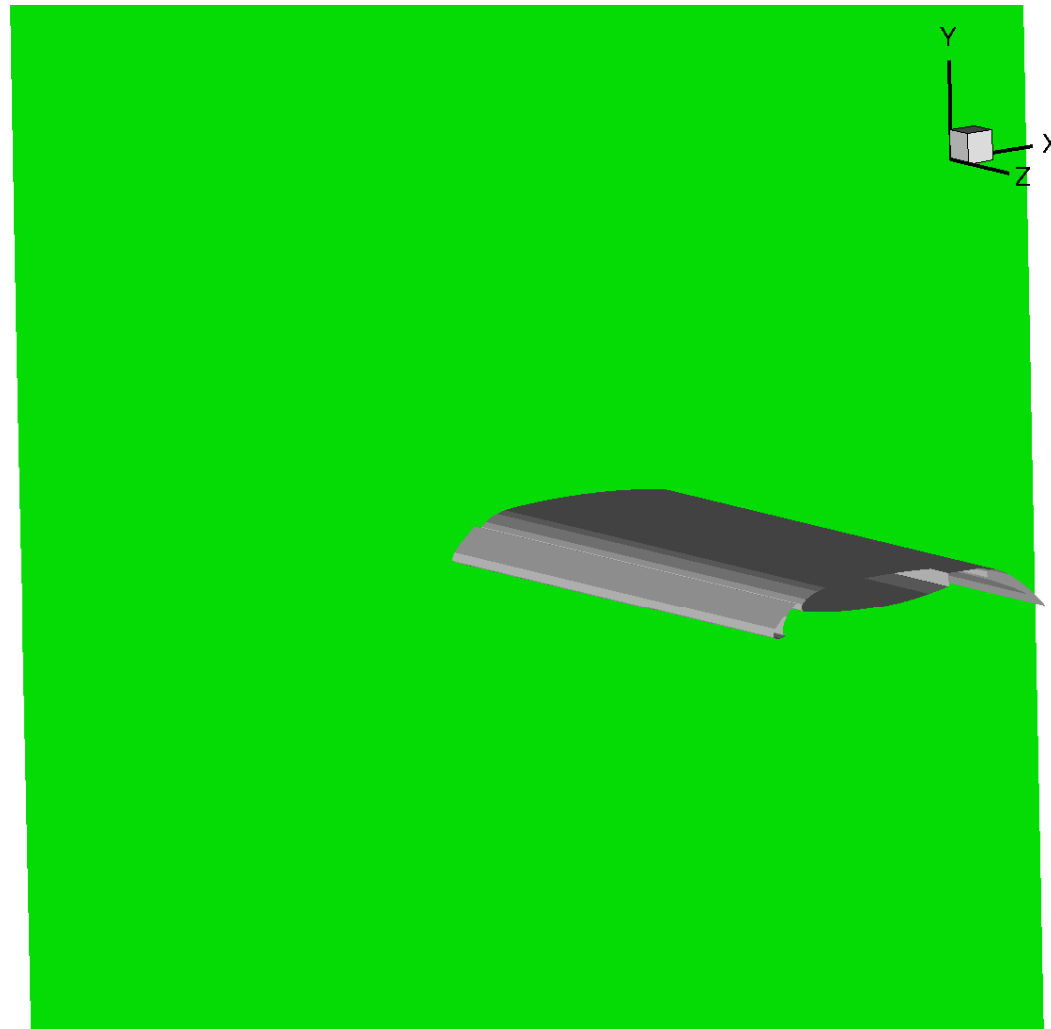
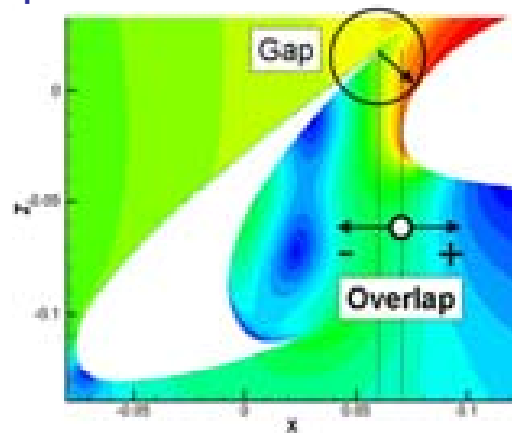




# Slat noise

## Slat setting variations

- Slat noise CAA (Computational Aero-Acoustics) simulation result for a conventional slat setting at a typical 3-element high-lift system
- sound wave propagation simulation to study various gap dimensions.





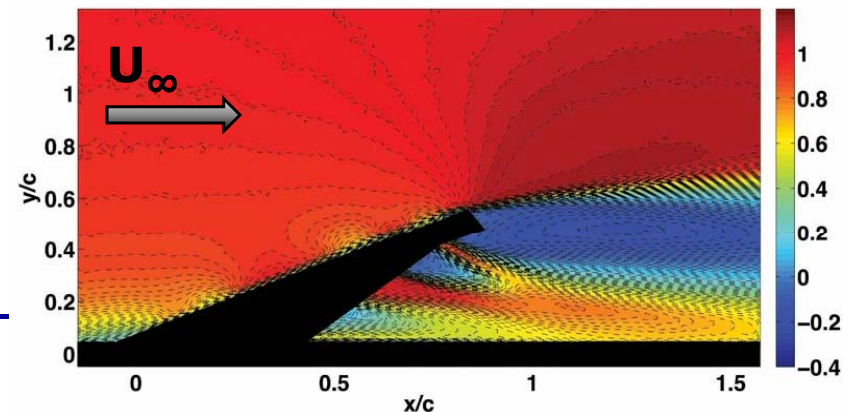
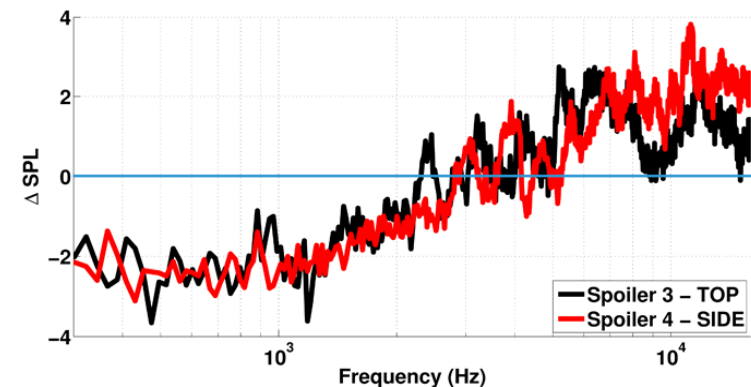


# Fractal Spoilers

Traditional spoilers generate a low frequency noise due to the re-circulating bubble.

Fractal spoilers are able to show a noise reduction in the low frequency range and a noise increase in high frequency. Resulting overall noise level will be lower.

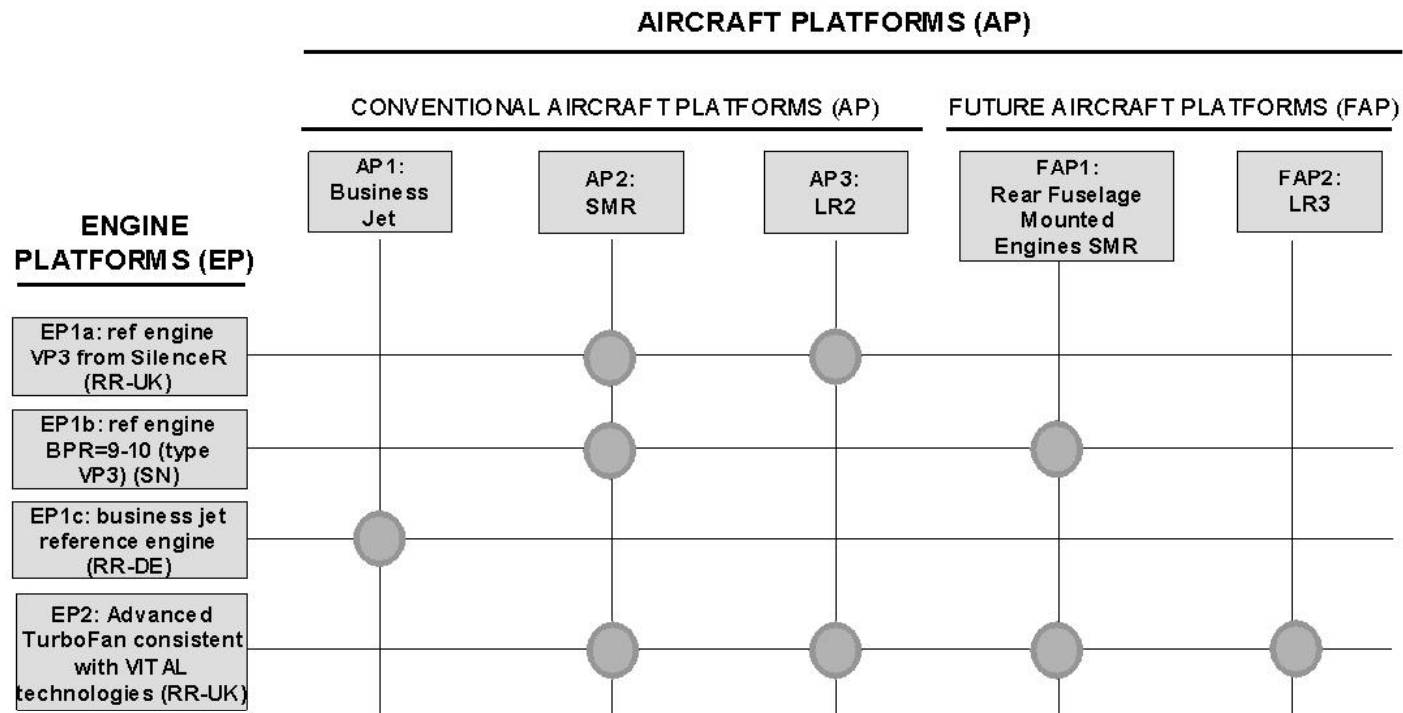
On a wing section, the fractal spoilers have shown to have the same lift and drag characteristics as traditional solid spoilers.





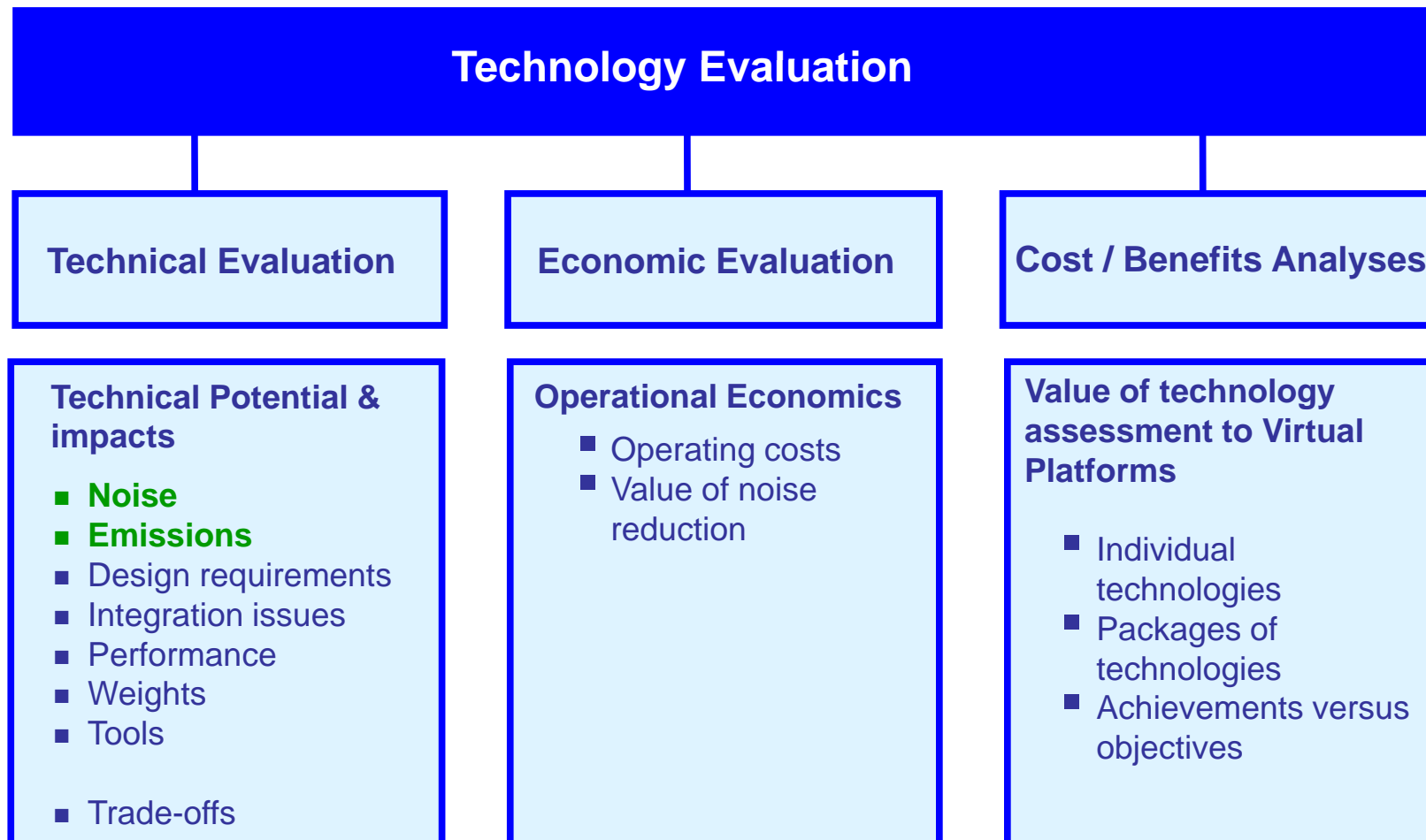
# Technology Evaluation

- **Configuration matrix example**, using a wide range of aircraft



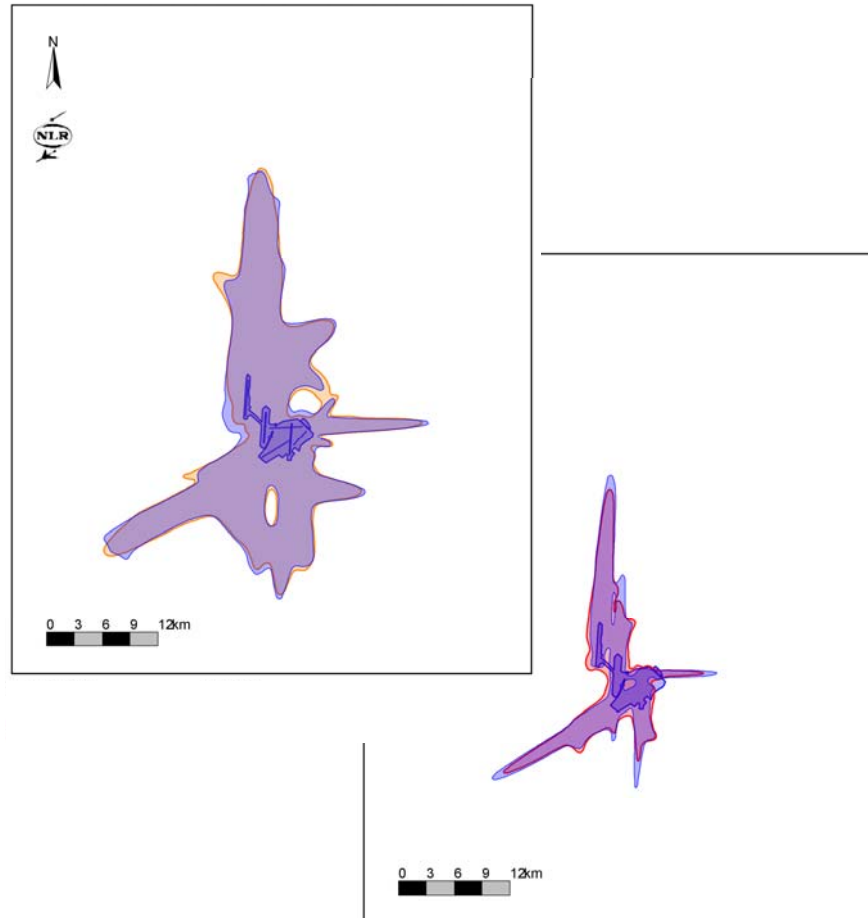


# Technology Evaluation: Key Elements





# Airport Noise Study example



- Footprint comparison
- Fleet equipped with and without Low Noise Technologies
- Unit: Lden
- Airport: Representative large European airport

Lden = Level day-evening-night = Noise level for 24 hr period with penalty for evening (+5 dB) and night (+10 dB)



Thank You  
for  
Your Attention

