

Beyond Concorde – Supersonic Research in Germany and Europe

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Knowledge for Tomorrow



Timeline Supersonic Aircraft – European Products & Concepts



1968

1979

2000

Now



The Legacy of Concorde

• Technical Perspective

- Aerodynamic design of an civil supersonic aircraft
- Plus: At that time advanced technologies e.g.
 - Flight control systems (incl. first FADEC in a civil aircraft!)
 - First of a kind carbon anti-skid brakes
 - Droop-nose
 - Variable engine intake design



Political Perspective

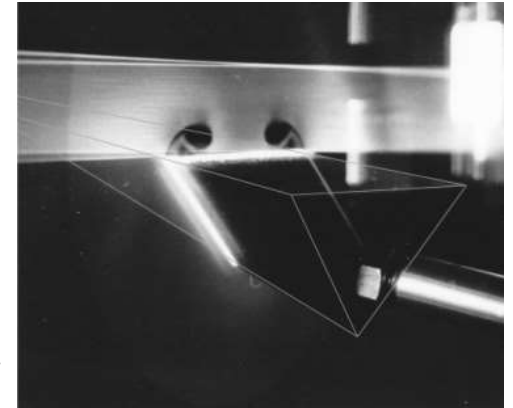
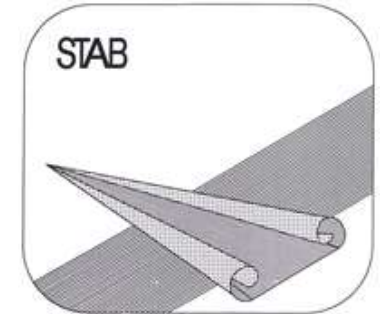
- Transnational civil aircraft development in Europe (between UK and France), paving the path for other programs and in the end Airbus (First of this kind was the military transport aircraft Transall with F & D, plus UK and It, started in 1958)



Concorde Signing Ceremony, Nov. 29th, 1962

Foundation of STAB 1978 in Germany

- A potential Concorde successor product has been a research topic for fundamental aerodynamics research
- In Germany, a scientific network has been founded by industry and research DFVLR: STAB (Stroemung mit Abloesung = Flow with Separation), covering all research areas of fluid mechanics for aircraft design
 - Strong focus on flight physics
 - Structured in project groups
 - Transport aircraft incl. engine integration
 - New aircraft configurations & multidisciplinary optimization
 - Turbulence research and modelling
 - Hypersonic Aerothermodynamics
 - Flow control, transition & hybrid laminar flow technologies
 - High agile configurations
 - Rotorcraft aerodynamics



At that time, the author worked on „The Leaside Flow Over Deltawings in Supersonic Flow“

Wind Tunnel with Super- and Hypersonic Capabilities in Europe (Examples)



Space Plane Designs: Sänger/Horus, Hermes, SFB 253, Spaceliner

- First idea of a two-staged hypersonic passenger spaceliner in Germany in 1940s by Eugen Sänger.
- First studies in Germany were carried out by Junkers, later by MBB (“Saenger II”)
- The French Centre National d'Études Spatiales (CNES) picked up on this idea in 1975, starting research on the Hermes spaceplane, later picked up by ESA (1987-1992)
- The Spaceliner idea was further investigated in Germany from 1989-2003 by network of universities funded by the German Research Foundation DFG (SFB 253)
- At DLR, a new Spaceliner has been investigated during the past years



Eugen Sänger



1961-1974, 1989-1992



Hermes

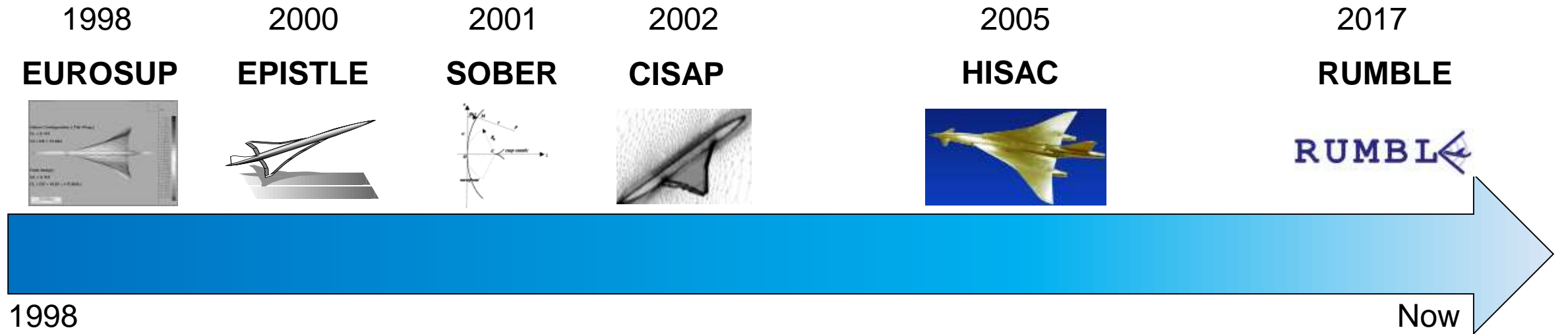


New Ways into Space



DLR Spaceliner (2005-)

European Research Projects on Supersonic Transport (last 20 Years)



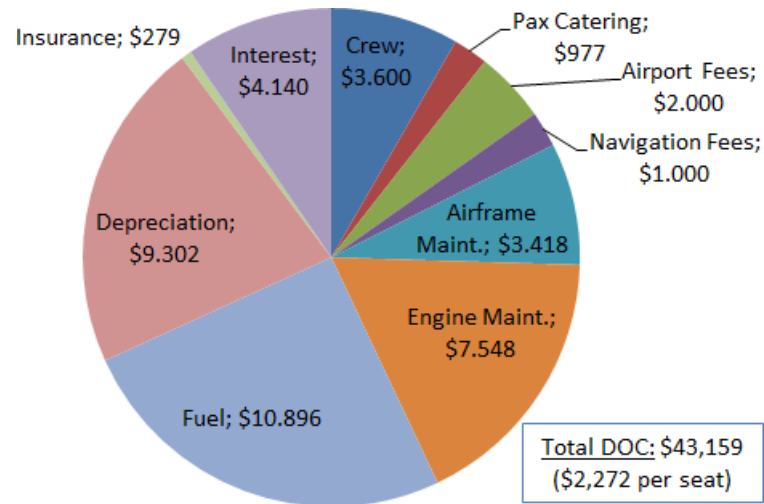
Participation of

- The European aerospace industry: Airbus, Alenia, BAE Systems, Dassault, Leonardo, Saab, Thales etc.
- The European aerospace research community: ONERA, DLR, CIRA, TsAGI, etc.,
- Many of European aerospace teaching universities

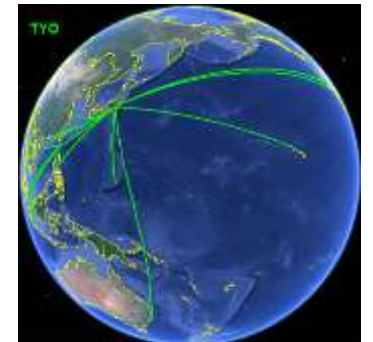
In Addition: Several Multilateral Cooperation, e.g. DLR/ONERA, plus DLR/ONERA/JAXA on "Sonic Boom Assessment for Future Supersonic en-Route Noise Standard"

Current DLR Activities in Supersonic Flight Research

- Design of supersonic routes, identification of possible transport hubs and flight frequencies
- Multidisciplinary optimization methods for preliminary aircraft design
- Simulation of the mission performance of different aircraft designs
- Assessment of operating costs and ticket prices
- Calculation of global aircraft demand and therefore market forecast



Estimated DOC of a 19-seat Aerion AS2 on a London – New York mission (3016 nm)
(3500 h annual utilization, fuel at \$2/gal, \$100M purchase price, 3500 h TBO, 5 % IR)



Summary and Outlook



Summary

- No other commercial supersonic aircraft has been realized after Concorde and Tu 144
- Infrastructures and technology know-how has been preserved around the world, used in military programs and research
- Spaceliners like Sanger/Horus remain a vision
- The German industry and research landscape focusses on the overall system and it's utilization

Thank You!

Outlook

- A new kind of “development pressure” may come from venture capital companies and/or “new economy” billionaires (e.g. Google, Facebook, Amazon), who want to possess such an aircraft for themselves or premium passengers
- Otherwise no urgent need to start a costly supersonic aircraft program (cost estimate >30 billion \$) for the established OEMs, as their order books for classic twin or single-aisle aircraft are completely sold out for the next decade
- **But: Research continues!**