SKY Aerospace Institute

Japan's Supersonic Technology and Business Jet Challenge

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Preface

Japanese researchers including the author (SKY aerospace Institute) are making efforts in the R&T programs for supersonics for more than two decades. NEXST for advanced aerodynamic design with computer simulation, HYPR/ESPR for high speed propulsion system, D-SEND for low-boom technology and so forth have been accomplished. The major accomplishments of those projects are useful for solving the critical issues such as noise, sonic-boom, fuel economy and thus the community acceptance for supersonics realization. A design trial of the supersonic business jet is under way by a Japanese team in cooperation with the industries, the academia and the research institutes managed by SKY Aerospace Institute.

1. Japanese Technical Achievement for Supersonics

(1) Aerodynamics

JAXA performed NEXST project (1997 to 2007) with the experimental airplane "NEXST-1" provided the technologies including natural laminar flow wing (NLF), aerodynamic integration and computer aided design system (figures 1,2,3 and 4). Tohoku, Nagoya and other major universities in Japan are also studying on the aerodynamics.

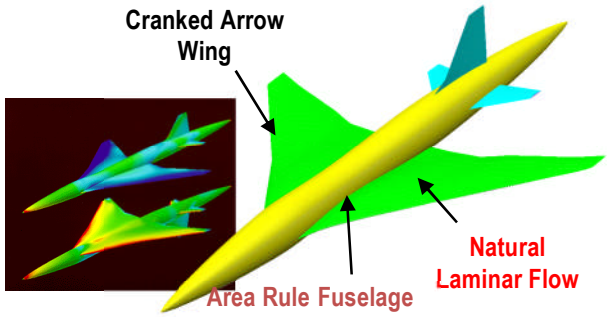

Fig.2 Aerodynamic technologies developed by the project and Pressure contours by CFD

Fig.1 Launch of the NEXST-1 Demonstrator at Woomera Test Range in South Australia (Oct. 2005)

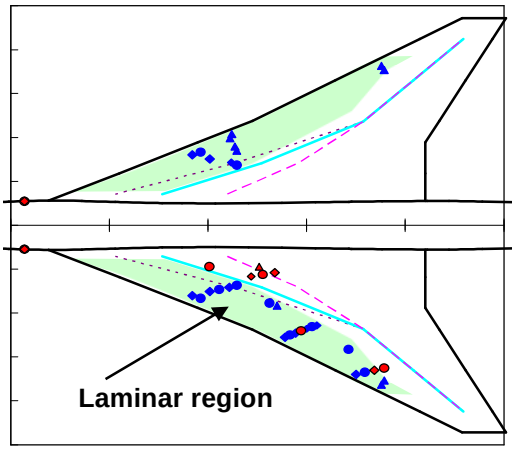

Fig.3 Demonstrated Laminar region on the wing upper surface

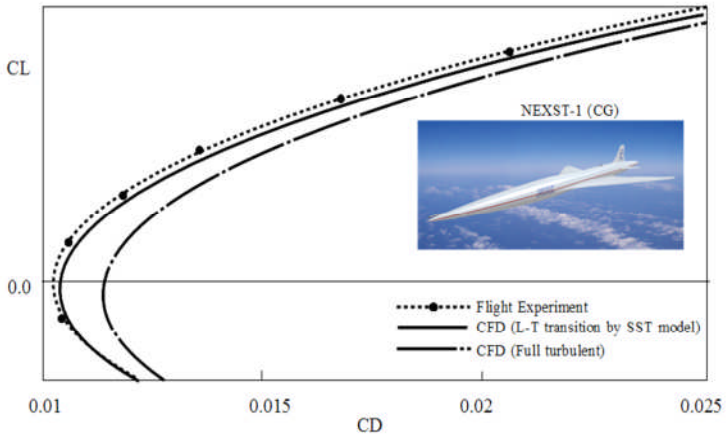

Fig.4 Lift/Drag ratio L/D obtained from the flight comparing with CFD design values(M-2.0)

(2) Sonic-Boom

D-SEND project (JAXA) with the model drop tests showed the superiority of Japanese technology for mitigation of the sonic boom (Fig.5).

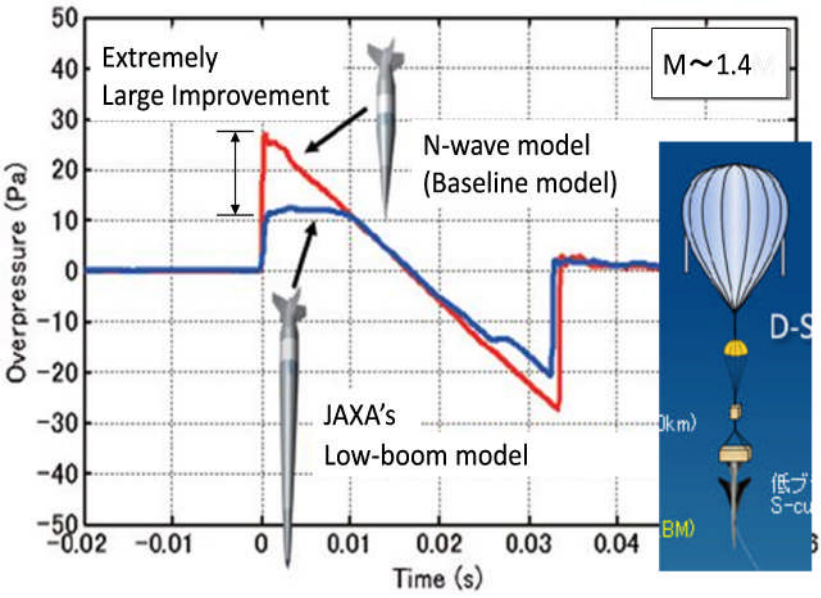

Fig.5 Demonstrated low boom technology by drop test (D-SEND1: M=1.4)(JAXA homepage)

(3) .High-lift devise.

Fig.6 shows a CFD prediction for the high lift device effectiveness. (JAXA and Tokyo Institute of Technology Suwa)

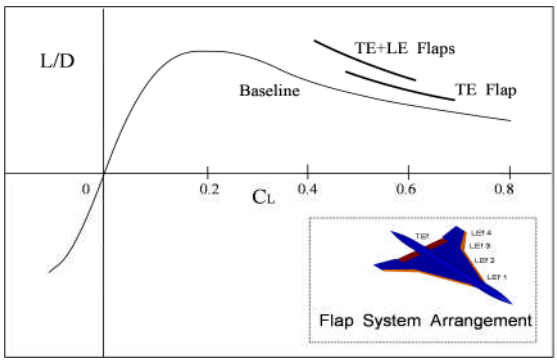

Fig.6 Flap operation in landing phase optimized by CFD

(4) Composite technology

Japanese technology for the composites is promising and competitive. The main wing of B787 and Japanese F-2 are the typical examples of success.

(5) Propulsion

Japanese HYPR project together with

Mach 2.5 low bypass turbofan ESPR engine demonstrator the technologies for engine system verification and demonstration for technologies such as combined engine system, noise reduction, phase transforming system and so on. Figure 7 is the ESPR demonstrator and Fig. 8 shows the noise suppression mixer-ejector length criteria derived from the experimental results.

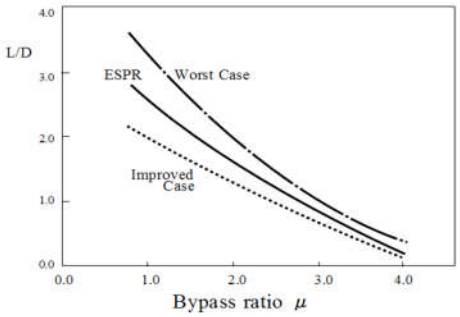

Fig.8 Necessary length/diameter ratio of the mixer-ejector

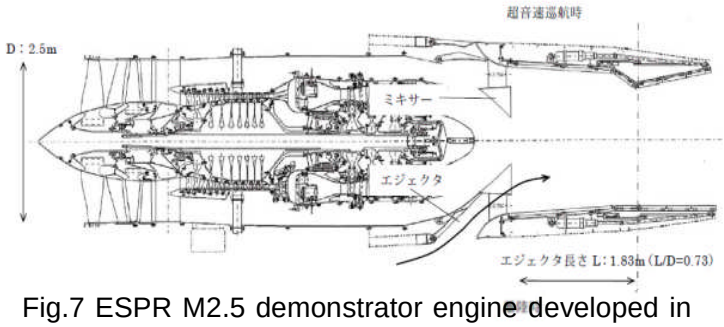

Fig.7 ESPR M2.5 demonstrator engine developed in HYPR project

2. Market Reality

There will be many possible and promising routs for the one day round trip between two major cities in the world. Around Japan, the major cities in Asia located within 3,000 to 4,000nm radius from Japan are growing economically and important to connect with rapid access.

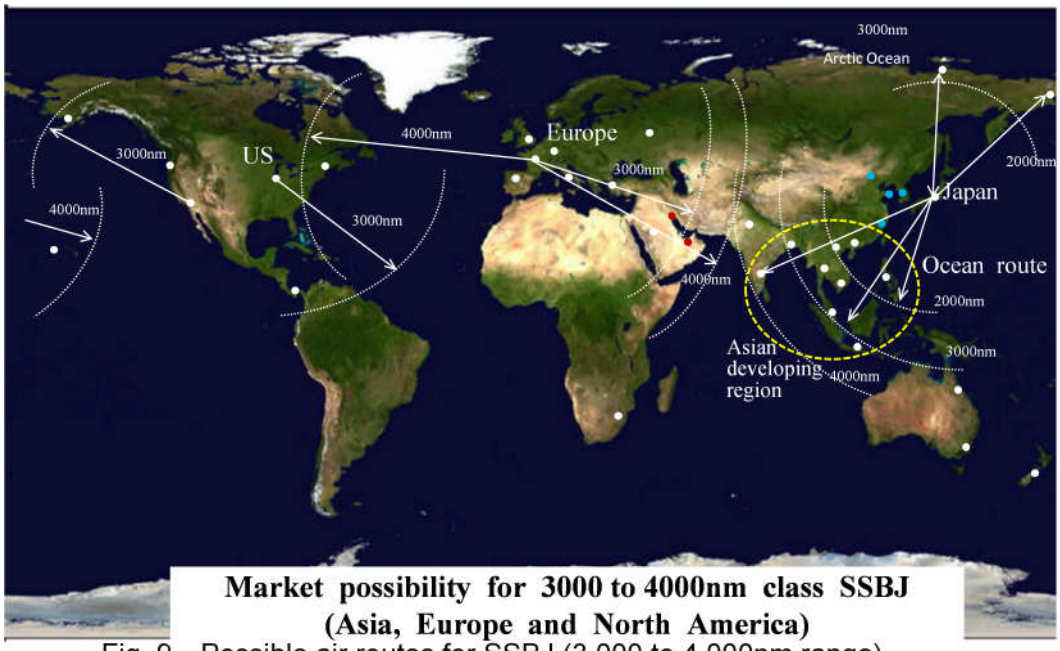

Fig. 9 Possible air routes for SSBJ (3,000 to 4,000nm range) in the near future