SSBJ DEVELOPMENTS

Putting a 'Q' into supersonic flight

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Private/Inst.

SAI and the 4000-nm range SSBJ—a design that combines speed, comfort and neighborliness.

A major question facing our industry today is simply "to be or not to be supersonic." Chuck Yeager broke through the sound barrier on Oct 14, 1947, yet commercial aviation has essentially been locked in a time warp for the past 60 years. So why are we still flying aircraft at 400–500 kts?

Yes, there was the ill-fated Tupolev TU144 and the renowned British Aerospace/Sud Aviation Concorde. Despite its incredible speed, the Concorde was doomed as a financial success partially due to its tremendous sonic boom and its 1960s technology Rolls-Royce/SNECMA Olympus turbojets, which produced an ear-shattering takeoff noise, and due to its afterburners that guzzled fuel at a time when petroleum embargos were in vogue.

Also, FAA's FAR 91.817 regulation restricted the Concorde to subsonic flight over populated landmasses. These regulations made airlines rethink investing in this revolutionary 100-passenger supersonic aircraft. Instead they chose new, high-capacity widebody aircraft such as the Boeing 747. Only 20 Concordes were built, of which 14 entered commercial service.

However, the Concorde's speed advantage made it a favorite with passengers, despite high ticket prices. Business travelers commuting regularly between New York and London or Paris found the time savings significantly advantageous. And while only British Airways and Air France operated the Concorde for any time, the demand for fast transportation across the Atlantic kept it in service for an amazing 27-year period. The Concorde was an unequivocal operational success, a prime demonstration that "speed sells" and is still in high demand. Numerous market studies confirm a demand for 300–400 quiet supersonic transport (QSST)-type aircraft over the next 20 years.

So, considering those figures, why hasn't any company committed the resources to actually build a new supersonic aircraft? Despite numerous announcements over the past 2 decades about proposed supersonic business jets (SSBJs), the truth is that the aviation industry is primarily focused on "near-term" shareholder return. Thus, any "long-term" project, such as an SSBJ, suffers.

Second, the market dictates that any new supersonic aircraft must have the "Q" of quiet design to be a success. And this undoubtedly has to come from a company with the resources and critical supersonic design expertise to accomplish this feat—something only a few companies in the world truly have.

Third, despite many complaints among travelers about long overseas flights, the truth is that everyone has become complacent with our subsonic transports. Therefore, no major airframe manufacturer is going to invest the capital and resources to accomplish this formidable endeavor. To make a change we need aviators, business and government leaders to demand that the aviation industry provide the 21st-century traveler with something that is bold and new—not a "repackaged" derivative aircraft from a past era. As long as there is high demand for subsonic business aircraft, the industry will stay with the status quo.

Time savings

From my days at Gulfstream, I know first-hand that there is a consensus among pilots and passengers that being locked up in an aircraft for anything over 8 hours is too

Patented design of Supersonic Aerospace Intl (SAI)'s revolutionary quiet supersonic transport (QSST) takes the boom out of supersonic flight. With the prospect of flight being allowed over continents, a 2.5-hr flight from New York to Los Angeles may be possible in the foreseeable future.

long. The new ultralong-range business aircraft are now capable of 14 to 15-hour flights—way too long, no matter how comfortable the accommodations may be. What's next? A Mach 0.80 aircraft with 20-plus hours' range? Let's hope not. Global transportation truly needs a new revolutionary quiet supersonic mode of transportation for the world's leaders in business and government.

My late father, Allen Paulson, former owner and CEO of Gulfstream, made it his passion to find a path that would lead the market to a truly revolutionary supersonic aircraft. From the late 1980s until his passing in Jul 2000, he tirelessly advocated research to see if it was possible to tame the sonic boom, with the goal of supersonic travel over continental land areas.

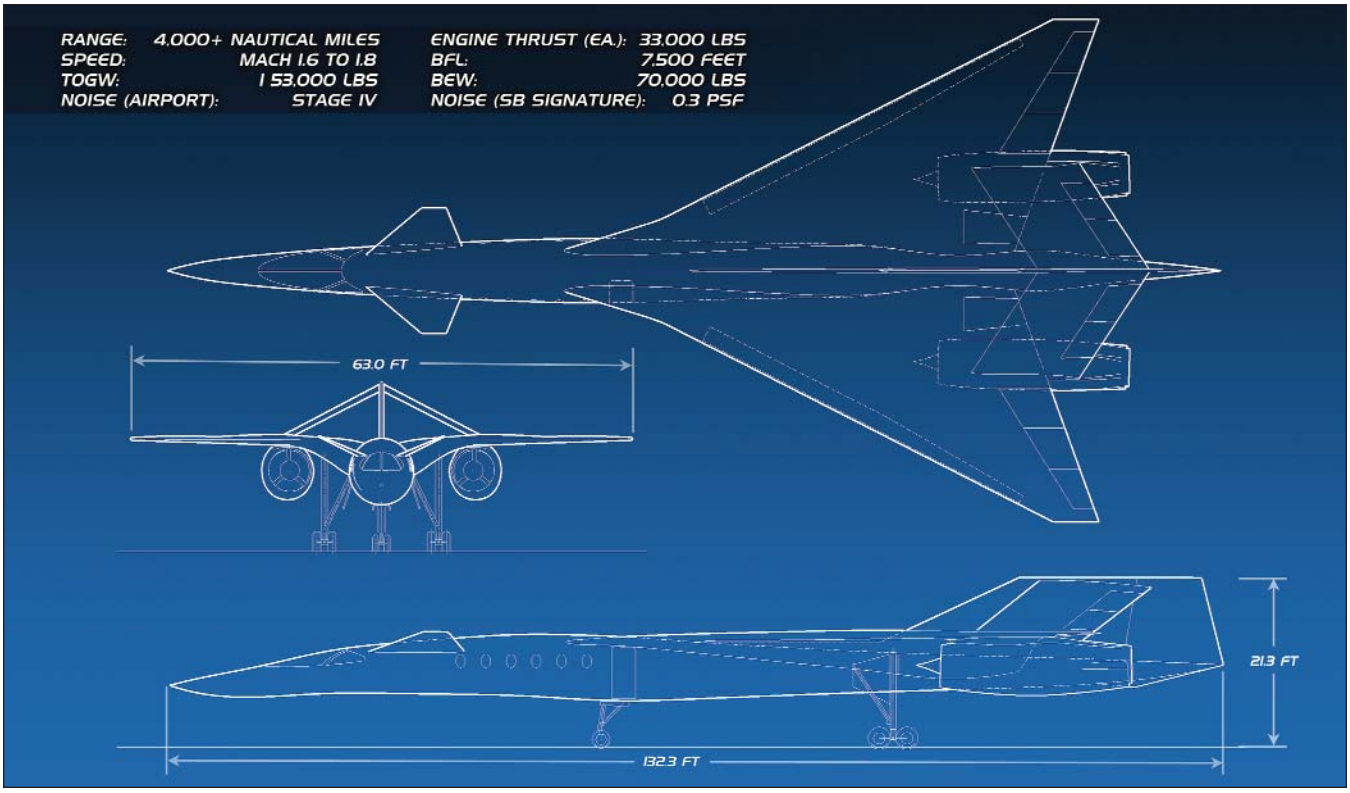
In his final years he began talks with the design team at the famed Lockheed Martin "Skunk Works." My father taught me early on that "to achieve the best, you surround yourself with the best." He lived by this credo and chose to work with the Skunk Works due to their renowned aviation engineering expertise, especially with their 5 decades of work on revolutionary supersonic aircraft that included the amazing SR71 Blackbird, F104 Starfighter, and the F117 stealth fighter, to mention a few.

Answering the essential question

My father and I agreed that initially it would be too complicated and take too long for US government assistance. To make our quest possible, we needed an answer to the essential question: "Is there a quiet supersonic aircraft design that could mitigate the sonic boom enough for high prospects of receiving governmental authority to fly at supersonic speed over the continental US and global populated land areas?"

As my father noted in a Nov 1999 article in *Pro Pilot*, Lockheed Martin had completed some conceptual "low boom" designs that they thought had some promise—in theory. However, to determine if this was possible, Skunk Works believed there was a need to perform an extensive design feasibility study. In early 2000, we asked their design team to give us a cost proposal toward completing a Phase 1 feasibility design study to answer that essential question.

Photos courtesy Supersonic Aerospace International



Dimensions of SAI's sleek QSST design would ensure size compatibility with most of today's FBO and corporate hangars.

We soon received their cost budget and, thanks to my father's unwavering commitment to quiet supersonic flight, he dedicated funds to complete this work knowing that he would not see his vision fulfilled. In one of our last conversations, I promised that I would make it my mission to bring a revolutionary quiet supersonic aircraft to market.

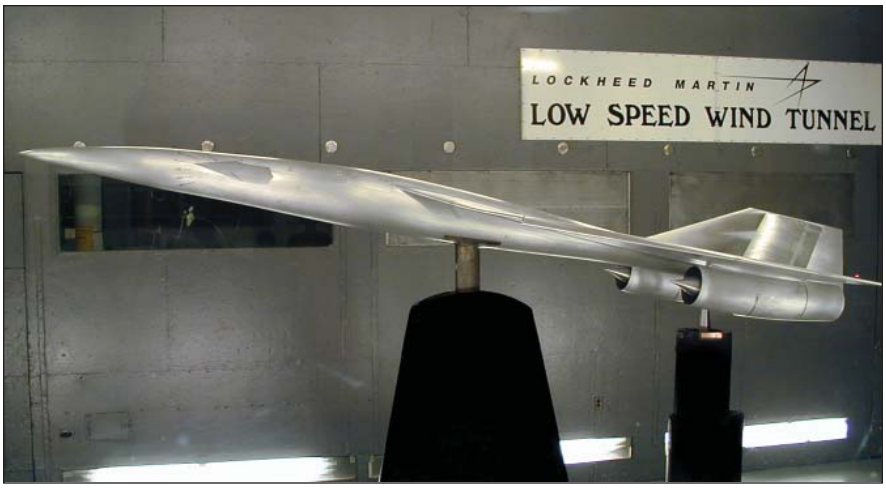
Quiet supersonic transport

This brings us to our QSST program. I continued to engage Lockheed Martin on establishing a program and founded Supersonic Aerospace Intl (SAI) to fulfill this endeavor. In May 2001 we finalized our contract with Lockheed Martin for the critical Phase 1 study, which used the Skunk Works facilities and staff in Palmdale CA. During the initial program, up to 40 of its top designers and engineers performed the work, which was kept in secrecy until we announced the project at the 2004 NBAA Convention in Las Vegas NV.

Clay Lacy, a longtime family friend and renowned aviator, collaborated with me and the design team to establish the QSST's threshold design goals. To answer the essential question, foremost of importance was that the design had to be exceptionally quiet, so the team concluded that the maximum acceptable sonic overpressure could not exceed .5 psf to achieve a "low boom" design.

Also, the aircraft had to meet the latest FAA Stage 4 noise standards, as well as those of EPA, to make QSST environmentally compatible using state-of-the-art airframe and engine technology. During Phase 1 we engaged the 3 largest engine manufacturers—GE, Pratt & Whitney and Rolls-Royce—and concluded that a new turbofan engine design was achievable to meet the latest FAA and EPA standards, including sustainable supersonic flight without the use of inefficient afterburners, known as "supercruise."

Next, the aircraft required a minimum range with IFR reserves of 4000 nm with a long-range cruise speed of Mach 1.6–1.8, which would keep surface temperatures



This QSST wind tunnel model is one of many low and high-speed models used by Lockheed Martin's Skunk Works to validate the aircraft's performance.

SAI's QSST is designed to carry up to 12 passengers in large-cabin comfort, including more than 6 ft of headroom, a galley and full lavatory, and access to baggage during flight.

moderate and retain the ability to use conventional composite and aluminum construction. We also looked at a design to fly nonstop over 5000 nm, but the aircraft's size grew exponentially with range performance, which created other aerodynamic and operational challenges. So it was decided that this minimum 4000-nm-range threshold was the desired design goal. To confirm this decision, Lacy and I spent an afternoon plotting out the most common transoceanic routes flown. We concluded that a 4000 to 4300-nm range would be ideal, as this would accomplish most common city pairs without a refueling stop, as well as flying most of the longest global routes with one stop.

Third, the aircraft needed high dispatch reliability and no extraordinary operational characteristics so that it would fit right into any flight department. Lacy's first-hand knowledge of operating large FBOs assisted the design team in establishing acceptable operating characteristics, such as taxiway turning radii being compatible with regional airports used by business jets.

Lastly, the aircraft required a superior 21st-century cockpit plus the exceptional passenger comfort and amenities to which business travelers have become accustomed. Essentially, it required the attributes of current large cabin business jets such as the Gulfstream, to include stand-up headroom and adequate baggage space for up to 12 passengers, with easy flight accessibility.

Before we achieved the final QSST configuration, we studied nearly 40 different designs in an effort that took hundreds of thousands of engineering man-hours, including numerous supersonic and subsonic wind tunnel tests. Also, a flight test of a modified Northrop F5 fighter confirmed our nose design's ability to substantially mitigate the sonic boom.

All our hard work doing the feasibility study proved a resounding success when the essential question was met, exceeding all of our original threshold design goals. The QSST design was designated at Skunk Works as Model P422 in honor of my father's birth date.

Our 6-year work effort has resulted in over 20 US and foreign patent applications. The most striking feature is the inverted V-tail, which gives the QSST its unique look and is essential to achieving a shaped sonic signature. This and other critical aerodynamic features gives the aircraft an amazing 0.3 to 0.5-psf overpressure in supersonic flight, thus putting the "Q" in our QSST design, and making it over 100 times quieter than the Concorde.

Speeding toward the future

The Skunk Works team achieved an amazing result—one that I have personally witnessed in Lockheed Martin's acoustic simulator where they can simulate the Concorde and QSST under various settings. Essentially, it shows that we have virtually eliminated the boom. In a typical everyday metropolitan noise environment, the QSST has the ability to fly at supersonic speed overhead without even being detected. In the quietest settings, the simulator shows that the insignificant "rumble" directly below the QSST is a mere second and much quieter than a car driving by a home or office building.

I hope that this article will stimulate action within the aviation community to encourage the industry to step forth to create a revolutionary supersonic aircraft like the QSST. As the Wright brothers did last century, we need to be bold and committed to aviation progress in our second century of flight. To get QSST to market within the next 7 years requires a lot of resources that only an international consortium can accomplish, preferably with an existing OEM taking on the lead role of the QSST project.

In closing, I thought it apropos to mention a great lady—the late Moya Lear, wife of the legendary Bill Lear. In a May 2001 article for *Pro Pilot* which appeared under her name, she spoke of supersonic flight. She stated, "We need more Bill Lears—people with the vision and the commitment to stay the course because they believe in something." Also, a mutual friend told me that she stated, "If Bill could come back today to see that there wasn't a supersonic business jet built, he would be astonished and very disappointed." I'm sure if my father could somehow return in 2014, and saw that a QSST was not on any FBO ramp, he too would be astonished and disappointed.

Hopefully, we will see a QSST soon. I'll do my best to keep the promise I made to my late father, in seeing that the QSST becomes a reality. I hope that the business aviation community will do its vital part, too, and assist me in this worthy endeavor to revolutionize aviation in the 21st century. And I hope that revolutionary aircraft is the Quiet Supersonic Transport, Model P422.

Michael Paulson founded Supersonic Aerospace Intl in 2000 to fulfill his promise to create a revolutionary QSST for the 21st century. He is an experienced private pilot.