Everyone knows the Concorde, the fastest airplane for passenger transport ever. But many more supersonic aircraft were developed. In the mid-sixties, several companies tried to build their own supersonic airplane. To promote the development of a supersonic passenger aircraft, the American government even decided to support the development of a competitor for the Concorde. Both Boeing and Lockheed came up with a design, but their proposals never saw daylight. What were the difficulties encountered during the design process and the realization of these incredibly fast aircraft?

And why were they never produced?

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NST-PROGRAM
When in 1955 the French and British governments decided to work together on their prestigious project the ‘Concorde’, many problems occurred. Both with regards to political, as well as financial aspects, the development of the first supersonic passenger airplane encountered difficulties. Nevertheless, the idea of a supersonic transport (SST) was so exciting that in 1963 the government of the United States decided to start up their own National Supersonic Transport program (NST); every American aircraft producer could participate in the development of an American SST. The government decided to subsidize 75% of the development cost of the winning design. Important to note was that the aircraft should not only compete with - but actually be better than - the Concorde. With 250 passenger seats, an intercontinental range of 7,200 km and the possibility to fly at Mach 2.7-3.0, it should exceed the Concorde on all fronts.

To optimize the results of the program, Requests for Proposals were sent to both airframe manufacturers such as Boeing, Lockheed and North American, as well as to engine manufacturers like General Electric, Curtiss-Wright, and Pratt & Whitney.

L-2000
Lockheed was keen to accept the Request for Proposal, and came up with a design better known as the L-2000. This was the result of years of research in the area of SST designs. The paper studies in this field had already started in 1958, long before the NST program began. Initially, Lockheed strived for a SST with a variable geometry to ensure it would be able to obtain cruise speeds of about 3,200 km/h. After more consideration, Lockheed decided that the swing-wing design would become too heavy, and switched to a fixed-wing design. The swing-wing was intended to control the position of the center of pressure, so with the fixed wing design, another solution for this problem had to be found. Lockheed decided to control the center of pressure by shifting the fuel within the wings, using the same concept already seen in the Concorde. By compartmentalizing the fuel tanks, the fuel could be shifted from one compartment to another, making it possible to control position of the center of gravity and the trim of the aircraft.

The initial design, consisting of a tapered straight wing and a delta-shaped canard (for aerodynamic trim), proved to have an undesirable range of lift coefficients. The wing was replaced by a delta wing, which made the L-2000 more steerable, but Lockheed still did not consider this the ideal solution. In 1962 and 1963, more alterations were made on the L-2000, resulting in a wing that had a double-delta shape with camber and a mild twist. Compared to the original design, the wing
was also moved forward, cancelling the need for a canard. With the engines being mounted below the wings on individual pods, the final design of the L-2000 strongly resembled the Concorde.

**B-2707**

Boeing started research for its own SST long before the start of the NST program. In 1952 small-scale research was performed, to be followed by a permanent research committee in 1958. So when Boeing entered the competition, it was not much of a surprise that it chose the swing-wing design ‘Model 733’ which had already been studied in 1960. The swing-wing ensured high lift characteristics and, in combination with the sweepback wing configuration, enable high cruise speeds. When the airplane would take-off or land, the wing would swing into an (almost) straight position, making it a ‘regular’ delta-shaped wing. During cruise flight, with the desire for the highest possible cruise speed, the sweepback position would be used. The downside to this design was that the hinges of these kinds of systems are very heavy and complex. This made it less financially attractive than the fixed wing design Lockheed chose to go for. Based on Model 733, Boeing decided to come up with an enhanced design. The strict requirements of the FAA were taken into account, as well as one of the engine designs of the NST competition.

With these extra design constraints taken care of, Boeing presented the 733-290: a scaled version of the 733, now with 250 seats. The version was scaled up to 300 seats for the final selection in 1966. After a long review, Boeing came out of the NST competition as the winner on the 31st of December in 1966. The B-2707 (or Model 733-390) would be powered by General Electric engines.

**CANCELLATION**

In March 1971 however, the U.S. Senate decided to stop funding the development of the B-2707. But this was not the end of the B-2707 just yet. President Nixon’s administration was a very strong supporter of the project, as well as the ‘National Committee for an American SST’. This committee was created in order to complete the project, and asked everyone who supported the project to send in one dollar to continue the completion of the B-2707. The cancellation also resulted in letters of support from aviation companies (which were willing to contribute one million dollars to support the program) and labor unions. These unions were strongly in favor of the SST-project since they feared its cancellation would lead to mass unemployment in the aviation sector.

Nevertheless, this resistance could only postpone the end of the program. On the twentieth of May 1971, following the decision of the U.S. Senate, the U.S. Congress also decided to stop funding the project. Various problems, including technical difficulties, unclear economics, the uncertainty about sonic booms, ozone-layer concerns and skepticism within the government and industry, withheld the B-2707 from seeing daylight. Even the prototypes were never finished.

**SST IN THE FUTURE?**

The idea of supersonic passenger transport is still very appealing however. Therefore, even after the NST-program was cancelled, a lot of thought has been put into the development of a new SST. In the seventies, a program called ‘Advanced Supersonic Transport’ was started. Both Lockheed and Boeing started reconsidering supersonic transport. Boeing used its B-2707 as baseline for the new studies, whereas Lockheed started all over again and eventually came up with the Supersonic Cruise Vehicle. Both studies were unsuccessful, and the idea of SST gradually faded away in the early eighties.

By this time, regular aircraft - such as the Boeing 747 - had taken over the market with impressive advantages over SST in fuel costs and the amount of passengers that could be seated. The only SST that was able to remain in service next to the normal passenger airplanes was the Concorde. When it retired in 2003, EADS almost immediately came up with new plans to make an even bigger and faster SST. But it seems that, without a new type of propulsion, SST will be just too expensive to compete with the new generation of passenger aircraft.

**References**

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**Aviation Department**

The Aviation Department of the Society of Aerospace Engineering Students "Leonardo da Vinci" fulfills the needs of aviation enthusiasts by organising activities, like lectures and excursions in the Netherlands and abroad.