Private and Confidential

Third ~~Second~~ Draft
TJD : 3/~~5~~/65

MEMORANDUM

Subject: The American Supersonic Transport

I. The Problem

In the next ten years, we are planning to build in the United States four types of long-range commercial air transports. They are:

1. Additional Boeing 707's and Douglas DC-8's
2. "Stretched" versions of these aircraft
3. A very large "jet bus"--the C-5A
4. A supersonic transport

Projected performance characteristics and estimated production and operating costs for these aircraft are outlined on the following page.

The 707 airframe, and engines for the entire present generation of long-range transports were developed largely at government expense, in response to military requirements. The DC-8 and Convair 880 airframe programs benefited substantially, if not directly, from government expenditures which led to the 707.

Stretched versions of the 707 and DC-8 are natural outgrowths of their predecessors. Development costs on the scale necessary for a new aircraft are not required.

The C-5A is being developed at government expense, in response to a military requirement.

There is no military requirement for development of the SST, and no precedent for development at government expense of a transport aircraft intended solely to serve commercial markets.

In the development and manufacture of the SST, there are unprecedented technical, operational, and economic problems

Projected American Long Range Civil Air Transports

1965 - 1975

Type	Cruise Mach	Maximum Range(a) (St. miles)	Maximum Passenger Capacity	Max. Gross Take-Off Weight (M#)	Projected Production Quantity	Unit Cost	Direct Operating Cost(b)	Service Date
1. Additional 707's & DC-8's	.80	5500	189	258-335	100	7	0.77¢	1965
2. Stretch Versions of 707 & DC-8	.80+	5500	200-250	330-410	100	8-10	0.65¢	1967
3. C-5A	.78-.82	7000	500-750	660-750	200	17-20	(c)	1969
4. SST	2.7-3.0	4000	225	425-500	200-300	20-40	0.95¢(d)	1973

(a) Typical ranges (in statute miles):

New York - Los Angeles	2500		New York - Rome		4200
New York - London	3500		New York - Buenos Aires		5300
New York - Paris	3800		Tokyo - Los Angeles		5400

(b) Direct operating cost (including depreciation) per available revenue unit (one passenger and baggage or 400 pounds of cargo) statute mile at 3400-mile range (most favorable for SST; see Figure 3)

(c) Estimated in the press at 25-40% below direct operating cost for present 707's and DC-8's Phase 2A

(d) For a more optimistic forecast, see the final paragraph of Section III

Figure 1

to be resolved. Development through FAA certification may cost as much as $2 billion. The production commitment could reach $10 billion.

(1)

The American aircraft industry lost $1 billion producing the first jet transports, although the government bore most of the development cost. It took twelve years from the start of prototype work on the 707, the civil version of the KC-135, before Boeing broke even on production of this aircraft. No American airframe manufacturer is strong enough to risk estimated development costs for the SST airframe. The net worth of Boeing, which has the highest equity capitalization in the aircraft industry, is $275 million. The net worth of Boeing, Douglas, General Dynamics, Lockheed and North American combined is only $1,191 million. (Update when 1964 statements available.) U.S. engine manufacturers, particularly General Electric and to a lesser extent United Aircraft, are in a stronger position, but the SST engine development risk looms very large to them as well.

(2)

The major American airframe manufacturers have existed for years in an atmosphere of dependence on the government on the one hand, and of competition and intercompany independence, particularly in the commercial field, on the other. The few joint ventures attempted in the past were not notably successful. Committee management is viewed unfavorably. Each manufacturer working on the SST believes the government will assume most, if not all, of the development risk, and that the winner of the development competition will be himself. Against this background, prospects for a consortium of manufacturers to share the risk of SST development are beyond reasonable expectation.

The procurement capabilities of the U.S. aircraft manufacturers are surprisingly unsophisticated, considering that more than half their work, including to-be-developed components, is customarily performed out of house. Procurement has not, customarily, been the direct responsibility of top management in U.S. aircraft manufacturing companies. Therefore, SST development and production costs, if management of the SST program is to be left to the manufacturers, may be expected to be excessive.

Should this be left out? Are SUPERSONIC really dealing with this?

Purchases of subsonic jets transports have left the airlines, domestic and international, heavily in debt. Because

Substitute (1)

Despite the fact that the government bore most of the development costs, the American aircraft industry lost $1 billion selling the first jet transports. Convair reportedly lost $425 million on the 880 and 990, which are no longer in production. Douglas is still roughly $100 million behind on the DC-8. It took twelve years from the start of prototype work on the 707, the civil version of the KC-135, before Boeing broke even on production of this aircraft. American supersonic jet transports are an outstanding success today, but the industry competition which in part made this possible was carried too far. It would not be intelligent to let this happen again.

This cannot happen again without jeopardizing the future of the industry. No American airframe manufacturer alone is strong enough to risk estimated development cost for the SST airframe. The net worth of Boeing, which has the highest equity capitalization in the aircraft industry, is $275 million. The net worth of Boeing, Douglas, General Dynamics, Lockheed and North American combined is only $1,181 million.(Update when 1964 statements available) U. S. engine manufacturers, particulary General Electric and to a lesser extent United Aircraft, are in a stronger position, but the SST engine development risk looms very large to them as well.

Substitute (2)

This paragraph is not convincing as it stands. It needs to be beefed up.

Why joint ventures not notably successful?

So what if committee management unpopular?

these aircraft have proved profitable in commercial service, the airlines are expected to be able to retire this debt, but they will face massive problems in financing purchases of a proven SST, and they are not strong enough financially to risk SST development. If they could, politics would probably dictate developing and producing the SST under the auspices of a consortium of governments, or something like the International Air Transport Association. Then, the development and production contracts would be divided among several countries, at higher cost and to the serious detriment of the U.S. balance of payments.

Commercial air transports have been produced to date by a few competing manufacturers, each dealing individually with many airline customers, no two of which have precisely the same aircraft requirements. This has led to production by the competing manufacturers of several basic aircraft types in several versions each, each version being produced with minor additional variations designed to adapt the aircraft further to the specialized requirements of individual customers. However, proliferation of species has been costly to the airlines and the traveling public. If this ~~the~~ traditional pattern is to characterize development and production of the SST, it can conceivably price the SST ~~out of sight~~ so high that direct operating costs (which include depreciation) per available seat mile will exceed those of subsonic competitors.

Although Congress has appropriated $91 million to date for payment of 75% of industry's costs in the course of Phases 1, 2A and 2B of the FAA-sponsored preliminary SST design studies, there is substantial opposition in Congress to appropriation of taxpayers' funds to develop the SST (e.g., Senator Proxmire.) Those in Congress who favor having government assume the development risk (e.g., Senator Monroney) fear the heavy government involvement in administration of the program which inevitably would result. Among other things, this would entail higher cost, and a serious conflict of interest, since the government must certify the aircraft which is developed. At the end of January, Senator Monroney said: "The most tragic mistake we could make would be to establish a government procurement officer czar of the program and come up with a plane he likes, but one that the airlines will not buy. It is at this stage, the detailed design of the plane — that government should fade into the shadows and private enterprise assume responsibility". (As quoted in AVIATION WEEK & SPACE TECHNOLOGY, February 1, 1965, p. 34.)

Industry leaders (e.g., William M. Allen, president of Boeing) and the airlines fear government control of SST development for the same reasons.

* * * * *

Nevertheless, an American supersonic transport should be built because:

1. It is believed to be technically, operationally and economically feasible. FAA Administrator Halaby, in a status report to the House Science and Astronautics Committee at the end of January, said design work to date shows that a practical, safe SST can be built. Mr. Halaby also said that no damaging effects to structures have resulted in the current sonic boom test at White Sands, New Mexico. About 900 boom runs by aircraft have been made with overpressure levels up to 24 lbs. per sq. ft., and a 600-boom test is now under way to analyze the effects of frequent exposure to overpressures of 5 psf (as reported by AW&ST on February 1, 1965, p. 34; the overpressure limits set by the FAA in its Request for Proposals for Development of a Commercial Supersonic Transport (8/15/63) were 2.0 psf during acceleration, 1.5 psf during cruise and descent)

2. Substantial demand for a proven SST appears to exist. By February 1, domestic and international airlines had already purchased (at $200,000 in cash each) 96 delivery positions for the American SST.

4. There is the threat of competition from the French and the British, and potentially the Soviets. Although the Anglo-French Concorde is being designed as a lower-performance aircraft than we are contemplating (cruise Mach of 2.2; aluminum airframe without the "growth" potential of titanium), and although development has been slowed by current British economic difficulties, metal has already been cut, and substantial orders have been placed by airlines, including U.S. airlines. The British and French governments have committed over $800 million so far to development of the Concorde, without any contribution from private industry or plans

3. There is available capacity to design and build an American SST and idle investment capital seeking a fair return.

for airline reimbursement of government development costs. If the Concorde is produced, U.S. airlines will fly them out of necessity, but at a competitive disadvantage to British and French airlines and perhaps others. According to an Associated Press dispatch from Moscow of February 22, "A Russian aircraft designer has hinted that the Soviet Union will put into operation by 1975 an airliner capable of flying 1500 miles per hour."

5. It is in the national interest ~~generally~~ commercially and militarily that the leadership of the U.S. aircraft industry and U.S. airlines be maintained.

how much? taxes

6. American aircraft exports account for important employment and wages in the aircraft and engine industries, their subcontractors and suppliers.

7. American aircraft exports contribute importantly to the U.S. balance of trade and are thus important to our balance of payments. According to Senator Monroney, if the U.S. does not build a supersonic transport, the nation stands to lose $10 billion in balance of trade and up to $1 billion a year in airline profits by 1980 (AW&ST, February 1, 1965, p. 34).

~~7. National prestige is at stake.~~

II. Conclusions

In the light of the foregoing, the following conclusions appear warranted.

1. The executive branch of the government should revert to its customary roles as technical adviser and airworthiness certificator, to the exclusion of any involvement which entails the exercise of control over SST development or production.

2. The "czar" should be

private
~~all~~ American controlled
independent of the aircraft industry
~~independent of the airlines.~~

3. Financing of development as well as production should be private, based on a government guarantee of obligations sold to finance development, and no further appropriations should be sought from Congress.

III. Proposed Solution

1. Organize privately the Supersonic Transport Corporation (SUPERSONIC) to manage the development, production, subcontracting, financing and distribution of the American SST. The stock of this corporation should be in private hands — financial and technical, not industrial. Public participation at some point will probably be desirable. The president of this corporation should be a man of recognized stature, and wide industrial and financial experience. He should have a small, but highly qualified, staff of technical, industrial, financial and management personnel.

2. Invite all airlines, domestic and international, which are potential customers for the American SST to organize privately a spokesman. SPOKESMAN would act on the airlines' behalf, and speak with one voice as SUPERSONIC's customer during development of the aircraft. SPOKESMAN might be a corporation owned entirely by the airlines, in the same proportion that they hold positions on what is presently an FAA-governed delivery schedule.

3. Have SPOKESMAN reach concensus among the airlines on the SST specifications sought. These should not change materially from the "design objectives" already laid down by the FAA, although the specifications sought might be toughened significantly if it develops that more demanding specifications could successfully be met. To keep down cost, SPOKESMAN should insist on only two versions of the aircraft, transcontinental and intercontinental, with no material variations in either one to suit individual, as opposed to common airline requirements. SPOKESMAN would order development of the SST by SUPERSONIC.

3. Have SUPERSONIC take over the FAA's present role as program manager, and raise privately 85% of the estimated cost of SST development, based on a government guarantee of the obligations sold to raise these funds. This step relieves the

Substitute (3)

1. There should be organized privately The Supersonic Transport Corporation (SUPERSONIC) to manage the development, production, sub-contracting, financing and administration of the American SST. The president of this corporation should be a man of recognized stature, and wide industrial and financial experience. He should have a small, but highly qualified staff of technical, industrial, financial and management personnel. The voting stock of this corporation should be in the hands of SST customers - the airlines, domestic and international, and the general public. Aircraft manufacturers and the government should be excluded from voting participation. ~~Investment bankers and long-term institutional investors, which would later undertake debt financing of SST development and production, should also be excluded from voting participation~~. American airlines and investors should be in control. This corporation might be Congressionally chartered, like COMSAT. Equity capitalization of SUPERSONIC might be undertaken in the following steps:

1. Initial venture capitalization, in exchange for voting common stock, on the order of $1 million to be used for organization expense, early staff work, and presenting the SUPERSONIC concept to government, the airlines and aircraft industry. If SUPERSONIC is ultimately to be chartered by Congress, this step could be taken by a predecessor corporation, the stock of which would later be exchanged for founders' shares, at a modest premium, in SUPERSONIC.

2. Additional equity capitalization by airlines which are prospective customers for the American SST, on the order of $50 - $100 million, in exchange for delivery positions and additional voting common stock. Sliding scale premiums would apply to early delivery positions. Premiums would also apply to delivery positions taken after the initial closing. At an average of $500,000 for each delivery position, the airlines would be investing in SUPERSONIC only 1.25% to 2.5% of the presently estimated cost of the SST's. Deposits now posted by the airlines with the government for delivery positions presently assigned by the FAA would be refunded.

3. Public participation in an amount to be considered upon completion of step 2, by sale of additional voting common stock. If public participation were to match airline participation, the total equity capitalization of SUPERSONIC would range between $100 and $200 million.

Substitute (3) cont.

The Board of Directors of SUPERSONIC would be divided among the airlines, public investors and founders. If SUPERSONIC is chartered by Congress, additional directors appointed by the President, as in the case of COMSAT, may be appropriate. As a practical matter, the airlines would have the strongest voice in SUPERSONIC. Customers for the American SST, not the government, would direct its development and production. Foreign airlines would participate in Step 2, and foreign private investors could be expected to participate in Step 3 of the equity capitalization of SUPERSONIC.

2. SUPERSONIC should achieve consensus among the airlines on the specifications for the American SST which they seek. These should not change materially from the "Design Objectives" already laid down by the FAA, although the specifications sought might be toughened significantly if it develops that more demanding specifications could successfully be met. To keep costs down, SUPERSONIC should insist on only two versions of the aircraft, transcontinental and intercontinental, with no material variation in either one to suit individual, as opposed to common airline requirements. SUPERSONIC would act on the airlines' behalf and speak with one voice as the aircraft industry's customer during production and development of the aircraft.

Substitute (4)

3. SUPERSONIC should take over the FAA's present role as program manager, relying for the balance of the funds needed to pay SUPERSONIC's share of estimated SST development costs on private long-term financing, based on a government guarantee of the obligations sold to raise these funds. This step relieves ...

the favorable effect which sales of an American SST - if it can be developed successfully - would have

government of the program except as guarantor of the development obligations and certificator of the aircraft. It eliminates the FAA's present conflict of interest and will reduce the cost of the program. Also, it obviates Congressional appropriation of the development costs. ~~The effect~~ on the U.S. balance of payments is the most widely acceptable justification for extension of the government guarantee. Although the government has not, to our knowledge, previously guaranteed a short term equity risk by private enterprise, there are many examples of other kinds of government guarantees, including FHA housing mortgage guarantees, AID extended-risk guarantees of private American investments in underdeveloped countries, and ~~Public Law 1017 of the 84th Congress, 2nd Session (1956). This law amended~~ Title XI of the Merchant Marine Act of 1936 ~~to place the full faith and credit of the government behind 100% of~~ guaranteeing ship mortgage bonds issued under its provisions. Such mortgage bonds can be issued up to 87.5% of the cost of construction. The government might charge a point or so for extending the SST guarantee. If Congress is obliged to appropriate a reserve to back the guarantee, this appropriation would be much preferable to direct support of development, because development would be in private rather than government hands. Development cost obligations would be sold in blocks by SUPERSONIC, perhaps annually, as SST development requires. To the extent that foreign investors purchase these obligations, the U.S. balance of payments would be additionally benefited as they are sold.

4. SUPERSONIC should stage a design and development competition leading to manufacture and testing of two different airframes and two different engines. SUPERSONIC would select two airframe development bidders and two engine development bidders. Conceivably, competing development proposals will not differ sufficiently to justify construction of two different airframe and/or engine prototypes. Another possibility is that one airframe or engine development proposal may be convincingly superior on paper. However, present indications are that a conservative strategy will dictate building and testing two different airframes and two different engines. ~~What follows is based on this assumption. In any event, each prototype airframe built should be built in duplicate. SUPERSONIC would pay 85% of the costs of all bidders, successful or otherwise, including reasonable profits, the bidders to bear the balance of the risk.~~ (5) Every advantage should be taken of NASA and USAF technical advice, and useful government wind tunnels, engine test cells and related facilities at Langley, Cleveland, Tullahoma and elsewhere, the cost thereof to be borne by SUPERSONIC and bidders on the same basis. The risk borne by bidders should exceed the profit component of development design and development

Substitute (5)

Designs for the Boeing and Lockheed SST airframes, the two still contending in the FAA-sponsored competition, are now competitive on paper. Yet there is no way to tell now which will prove superior in the air. This situation also now exists with respect to the engine designs of General Electric and the Pratt & Whitney Division of United Aircraft. Accordingly, what follows is based on the assumption that two different airframes and two different engines should be built and tested. Each prototype airframe built should be built in duplicate.

5. SUPERSONIC should pay 85% of the costs including reasonable profits of all bidders, successful or otherwise, throughout the design and development competition, including testing. The bidders should bear the balance of the risk. Every advantage should be . . .

bids, to assure that bidders will call a halt to the program if and when circumstances indicate that a halt should be called. The government has borne 75% of preliminary design expenditures to date. However, only a consortium could bear 25% of the development risk beyond the paper stage. To have SUPERSONIC pay 85% of bidders' costs, including reasonable profits, should be about right. There should be one exception concerning the share of the risk to be borne by successful bidders in the course of development. If the program fails, and the reason for failure is insurmountable sonic boom problems (which should be determinable within the several hundred hours of prototype flight testing contemplated before production is authorized), SUPERSONIC would reimburse successful bidders for 80% of their participation, thereby exposing them to a much reduced risk.

8. Apart from the risk of failure, overruns on cost estimates are probably inevitable in the development program, and entirely possible in production. Overruns accounted for the serious losses suffered by the industry in the subsonic program. Competitors in the development program should accept some responsibility for their estimates. As to development cost, a formula whereby overruns come out of profits, at least to the extent thereof, combined with a ceiling on profits to discourage overestimation of cost, would be appropriate. (Overruns on production estimates would be entirely the responsibility of industry.)

7. SUPERSONIC invites ~~letters~~ of intent to purchase from the airlines. ~~SUPERSONIC~~, not the FAA, would preside over the delivery ~~schedule. SUPERSONIC would~~ charge sliding-scale premiums based upon the delivery position of each aircraft.

8. Prototype testing ~~is~~ should be conducted under the supervision of SUPERSONIC. ~~in cooperation with SPOKESMAN~~. During testing, all major technical problems anticipated, principally sonic boom, airport environment noise, and safety, would first be resolved. Then competing airframe and engine manufacturers would be called upon to submit production bids. This they would be in a position to do, once technical problems are behind them. Airframe manufacturers would bid as prime contractors. Engine, avionics, ground support equipment, etc. manufacturers would bid as subcontractors. On the basis of production bids, the economic viability of competing airframes and engines in simulated air-

Substitute (6)

Thus, if development costs reach $2 billion including $200 million of industry profits built into development costs, the aircraft industry ~~will~~ would have at risk at that point $300 million minus $200 million or $100 million, and SUPERSONIC ~~will~~ would have at risk the balance of $1,700 million, all thereof except the equity capitalization of SUPERSONIC being guaranteed by the government. If the program should be declared a failure at that point, the industry would charge off its share and take a loss, after taxes, of 52% of $100 million, or $52 million. SUPERSONIC would lose its entire equity, say $150 million, and the government would pay off the balance.

Airline stockholders of SUPERSONIC, acting collectively through SUPERSONIC,

line service would be measured in the course of further testing. ~~SPOKESMAN~~ would select the winning airframe and engine on the basis of best 12-year direct operating cost per available seat mile. Twelve years is the airframe life specified by the FAA for purposes of calculating depreciation; a 15-year life may prove to be an acceptable assumption. By basing the competition on direct operating cost over the life of the aircraft, long-term maintenance requirements would be properly evaluated. If the winning engine turns up in the losing airframe, a further round of testing may prove necessary before final prototype approval by ~~SPOKESMAN.~~ SUPERSONIC.

(7)

9. No production should be started, nor production tooling ordered, until all major doubts concerning sonic boom, airport noise, safety and economics have been resolved to the point where it makes sense to proceed with production. This point will probably be reached well before FAA certification, perhaps after several hundred hours of flight testing. If SUPERSONIC proceeds in this manner, the overall SST program will be less expensive, because less rework will be involved, and the financial risk will be significantly smaller. Although a delay in production until after the winning prototype is approved by SPOKESMAN will delay introduction of passenger service, it should not materially affect the U.S. position vis a vis the Concorde, which will probably not make its first flight until 1968. If we then have a prototype in the air, or if the airlines can see that ~~we will probably have it in the air at some time reasonably~~ soon thereafter ~~(which we should be able to do)~~, it is doubtful that the airlines will buy a Mach 2.2 aircraft when they can get a Mach 2.7-3.0 aircraft with "growth" potential.

we shall (a reasonable assumption)

10. SUPERSONIC should price production aircraft on the basis of the bids submitted by industry, the number of aircraft covered by airline ~~letters of intent~~ orders, and delivery position. The price of each production aircraft would be the sum of the delivery position premium, the production cost component, and the development cost component. The latter would include the SUPERSONIC share of design competition costs and development costs of ~~the~~ losing airframe and engine prototypes.

the SUPERSONIC share of

& the winning and

11. Airlines contract with SUPERSONIC for purchase of SST's, installment purchase, lease, or lease with purchase option.

and a reasonable profit for SUPERSONIC, in which the airlines would share as stockholders.

(7)

Insert here procedure whereby

withholds closer inputs are crashed
into winning airframe and engine
production is divided between winners
and losers so that both can
profit from SBT program

12. SUPERSONIC concludes production contracts with winning bidders. Incentive type contracts may be feasible. SUPERSONIC would insist on sophisticated and coordinated procurement techniques for dealing with sub-contractors and suppliers.

13. SUPERSONIC arranges production financing with airlines, manufacturers, banks, institutions, and the public. SUPERSONIC would hold title to all SST's not sold outright.

14. FAA certifies production prototype.

15. Airlines introduce the American SST into passenger service, recovering development, production, financing and operating costs, in part through application of a "Supersonic Surcharge".

16. The development obligations of SUPERSONIC are amortized as payments are received for aircraft. Alternatively, various royalty schemes could be considered. Since the justification for the government guarantee would then no longer exist, SUPERSONIC's development cost obligations could be refinanced.

* * * * *

A forecast of SST development and production costs follows as Figure 2. A forecast of direct operating costs follows as Figure 3. These forecasts may prove very conservative. Boeing President Allen was quoted as follows by AW&ST on February 1, 1965 (p. 33):

> "We find that the airplane can operate with a lower break-even load factor than existing subsonic transports on all but the shorter ranges, even after including amortization of prototype development and testing as part of the direct cost of operation per passenger mile."

" He said," continued AW&ST, "the break-even load factor on long hauls should not exceed 50%. Unit cost estimates of the airlines were speculative at present, Allen said, but he forecast that its price would fall between $20 million and $30 million." More re-

cently, a well-placed government official has declared privately that the SST now promises to have lower direct operating costs than even the stretched versions of the 707 and DC-8, and possibly the C-5A. This, he concluded, means that the market for the American SST would not be 200-300 aircraft but 700-800 aircraft and possibly more. The cut in unit cost and, thus, the depreciation component of direct operating cost which this factor alone would bring about is highly significant. If the market for the American SST proves to be this large, it might be able to support two producers of one or two different aircraft — AFTER the risk of development has been taken, successfully.

[Redrafted]

IV. Questions About the Proposed Solution

There are several questions about this proposed solution which need to be considered:

1. SUPERSONIC stands to make a killing. Is its existence and proposed role adequately justified? Why should it be our deal? How do we establish a franchise?

2. Congress may be unwilling to charter SUPERSONIC with a promotional bite to us in shares. Is there a more acceptable way to compensate originators?

3. What anti-trust problems will SUPERSONIC face? Will they be any more onerous than those that would be faced by a consortium of manufacturers or airlines? Would legislation be needed?

4. Will SUPERSONIC get along with its airline shareholders? What problems can we foresee with respect to the relationship between the two which has been proposed? Presently, individual airlines are dealing directly with both the FAA and each design competitor. Although the proposed relationships will simplify this state of affairs enormously, are there problems which should be anticipated?

5. Who should run SUPERSONIC? Who should be on the board?

Projected Supersonic Transport Development and Production Costs

	$ Million
Airframe	
Development	1,000
Production of 200 aircraft	4,500
Unit cost excluding development	23
" " including "	28
Production of 300 aircraft	6,425
Unit cost excluding development	22
" " including "	25
Engines	
Development	750
Production of 1200 (including 400 spares)	2,000
Unit cost excluding development	1.7
" " including "	2.3
Production of 1800 (including 600 spares)	2,870
Unit cost excluding development	1.6
" " including "	2.0
Complete Aircraft	
Development	1,750
Production of 200 aircraft	6,500
Unit cost excluding development	33
" " including "	41
Production of 300 aircraft	9,295
Unit cost excluding development	31
" " including "	37

Notes

1 - Includes airframe (10%), engine (50%), and avionic (25%) spares, but excludes ground support equipment, crew training, etc.

2 - If production is delayed until winning prototype is proven, these projected costs can be reduced 10%.

3 - If aircraft is developed by private industry instead of the government, except for government development cost guarantees, these projected costs can be reduced an additional 5%.

Projected Direct Operating Cost
Per Available Revenue Unit Statute Mile

Trip Length (St. miles)	Subsonic: Current DC-8 (DC-8-52	Subsonic: Stretched DC-8 (DC-8-62)	Phase 2A SST: Boeing GE	Phase 2A SST: Lockheed P & W	Increase: Boeing over Stretched DC-8
1,150	0.80¢	0.62¢	1.17¢	1.45¢	89%
2,300	0.74¢	0.59¢	0.95¢	1.12¢	61
3,400	0.77¢	0.65¢	0.95¢	1.05¢	46
4,020	0.76¢	0.74¢	1.30¢	1.54¢	76

Revenue Unit: One passenger and baggage or 400 pounds of cargo

Direct Operating Cost: As defined in the FAA Request for Proposals dated August 15, 1963, a modification of the 1960 Air Transport Association Cost Formula, and including:

1. Fuel @ 11¢ per U.S. gallon domestically; 12¢ internationally
2. Oil $12.00 per U.S. gallon
3. Flight and cabin crews
4. Insurance @ 5% of average initial investment per aircraft per year
5. Utilization @ 3,000 revenue block hours per year (including 30 minutes for taxi-in and taxi-out and 6 minutes for air maneuver per trip)
6. Depreciation (including amortization of development cost) based on 200 aircraft @ production rate of 2½ per month.

	Life (years)	Residual Value	Spares
Airframe	12	15%	10% - no residual
Engines	7	15%	50% - no residual
Avionics	5	0	25% - no residual

7. Direct maintenance per ATA Cost Formula

Not included are such indirect costs as aircraft and traffic services (e.g. communications, weather advisory, landing fees, ground servicing, etc), maintenance and depreciation of ground support equipment, passenger services and administrative overhead.