MARKET TRENDS

Richard D. FitzSimmons
McDonnell Douglas Corporation

SUMMARY

The public, by its reception and patronage of the widening Concorde supersonic service, will dictate whether a need exists for a second-generation supersonic transport. As of this writing, this need has not been demonstrated unequivocally; however, preliminary results are favorable . . . the public is willing to patronize supersonic service, even at premium fares, with marginal schedule frequency, and in less than spacious accommodations.

Without question, a second generation supersonic transport must meet society's needs, and at the same time be profitable for the operators and manufacturers, or such a program should not be initiated. Studies indicate that a design meeting the requirements can be described; however, unlike major civil aircraft developments of the past, an advanced supersonic transport cannot be conceived that would be economically competitive for <u>all</u> airline long haul passenger markets. The supersonic airplane direct operating costs (DOC) seem inherently higher than subsonic designs, both as envisioned today and for the foreseeable future. Accordingly, no case can be made for an AST to compete for the excursion traveler, who is economy minded and sees no economic value to increased speed.

A very large segment of the over water, long haul passenger market, 31% of the passengers who provide 42% of the passenger revenue, offers a significant market for an advanced supersonic transport. This is for both the first class and full-fare economy passenger markets. The supersonic transport may be more competitive here in spite of lower costs of subsonic transports, as passenger preference is a more powerful variable than DOC. This latter fact was amply demonstrated in the late fifties when the jets completely replaced the reciprocating engine transports on most world routes, in spite of slightly higher fares.

The civil aircraft market, through the year 2000, could reach 250 to 300 supersonic aircraft, given the timely availability of the necessary resources to undertake such a venture. Every indication to date is that a multi-nation, multi-government program may offer the only way such a program will come to fruition.

BACKGROUND

The North Atlantic air market, historically, has dominated world airline passenger markets, and a great deal can be learned from studying its operation. The market share split by mode started in 1959 with the initial offering of less-than-first-class fares. The response was overwhelmingly favorable and a large increase in passenger travel occurred. International air travel became the largest sustained growth segment in the airline industry (fig. 1).

The impact on the first class market is a fact well known to all airplane designers, as the bulkhead between the first class section and the lower fare passengers was moved forward in the airplane. This seemed to occur almost every time new data was available on the latest split between first class and economy. 1975 data shows first class is about 5.8% of the North Atlantic scheduled passenger traffic (fig. 2). Finally, some stability to the market split seems to have been reached.

A look at the fares (fig. 3) shows how extensive these reduced fares have become. The cheapest, the excursion fares,are only 30% of the first class ticket, whereas there was but one fare 25 years ago. Another interesting comparison can be made using the growth of the consumer price index (CPI). Here, the excursion fare is but 20% of what inflation alone, as reflected by the CPI, would have driven the fare to, and the first class fare is also low, being 30% below the CPI trend line. These are facts little recognized by some regulators or critics of the airline industry. Airline travel remains one of the best buys in the recently inflated economies of the world.

Unfortunately, good historical data are not available on the full-fare economy passenger market, but there are data for the first class passenger market (fig. 4). In spite of the surge in tourist and economy traffic, the first class market has continued to be a growing market. Since 1963, for 12 years, it has grown at almost 9% per year, a surprisingly healthy figure. One would expect that the full-fare economy class would have grown even faster than the 9% growth of first class.

High fare business will always be attractive (fig. 5). An analysis of the PAA and TWA data shows that these airlines in 1975 realized about the same revenue from first class than from their more heavily publicized charter business. And to realize this they handled only 1/4 as many passengers.

ANALYSIS

Initially, in the market analysis conducted in 1973 (fig. 6) in the NASA contract effort, McDonnell Douglas examined more than 500 city-pairs throughout the world for supersonic service for the period 1985-1994 considering 12 world market groups such as North Atlantic, Europe-Mid-East, and North and Central Pacific. The initial city-pairs met the following qualifications: overwater routes (some tag-end city-pairs were included for joining traffic), minimum city-pair distance of 1667 km (900 miles) and all city-pairs capable of generating sufficient passenger traffic during the period 1985-2000 to support scheduled supersonic service. An iterative process of computer-aided market analysis was undertaken for these combined world market groups in which market growth rates were projected from the base year 1975 to the year 2000. The supersonic revenue passenger-kilometers (passenger-miles) are estimated to grow from 87 billion (47 billion) in 1980 to 261 billion (141 billion) by the year 2000. This is a 5.7 percent average annual growth rate over the forecast period.

The resulting revenue passenger-mile distribution by range is shown. The importance of being able to design a 8334-kilometer (4500-nautical-mile) range airplane to do 80 percent of the business as compared to 6112 kilometers (3300 nautical miles) or 40 percent of that business is most significant. Both the Concorde and the last U.S. SST were designed for the shorter range. The advanced technology capabilities identified during the past 4 years in the cooperative NASA/McDonnel Douglas design studies show that a 8334-kilometer (4500-nautical-mile) range can be realized. As civil aircraft manufacturers know well, airlines like long range. The value of range cannot be under estimated in international service.

A comparison is shown of the payload range capabilities of the various important supersonic transport programs as compared to typical city-pair distances (fig. 7). The Concorde and the former U.S. SST both show limited range as compared to what can be predicted for an advanced supersonic transport as a result of the cooperative NASA-Industry SCAR efforts of the past four years.

The payload range shows a 8519-kilometer (4600-nautical-mile)capability for a near term airplane, for a go-ahead in 1980 which would use a low risk engine cycle. Also shown is what could be done with an advanced engine (possibly a variable cycle engine) plus a moderate use of composites both for secondary structures and for reinforcing the primary structure for this otherwise metal airplane. A range of 10,556 kilometers (5700 nautical miles) is possible, which approches the maximum ranges flown today by subsonic aircraft, which seemingly would satisfy future range requirements for a supersonic transport. Opening up the Pacific can become a reality and supersonic travel there can be especially appealing. Also shown is a 225-passenger design somewhat smaller than the DC-10-30 size used for the McDonnell Douglas baseline supersonic transport at 273 passengers. This seems to be a better size to match the passenger demand as a result of recently completed market trend studies. This subject of passenger size is discussed later in this paper.

Direct operating costs (fig. 8) in 1976 dollars have been recalculated since published 1973 results to include recent inflation both in manufacturing costs and in fuel costs. The results show a deterioration in direct operating costs of a 273 passenger supersonic aircraft as compared to a DC-10-30; however, the loss is not as great as many predict. Today, the supersonic aircraft direct operating cost is predicted to be 55% higher than for a DC-10-30 in similar seating configurations. In this comparison, in the prices used, there is a profit included in the supersonic aircraft airplane price as well as the cost of the money, whereas the DC-10-30 price has yet to reflect a profit. Direct operating cost of the Concorde is also shown for reference. A number of sensitivity studies have been made regarding increased jet fuel prices. Fuel cost accounts for a major fraction of the operating cost. The effect on the supersonic airplane of an increase in fuel cost from 12 to 35 cents per gallon, an increase of almost 200 percent in the cost of fuel, has been included in these cost comparisons. This impact is not as dramatic as one might expect. Looking to the future, we predict that increased labor expenses will have a greater impact on operating costs, for both subsonic and supersonic airplanes, than fuel expenses.

The total operating costs (fig. 9) show a better picture for the 273 passenger MDC supersonic transport, being only 28% higher than the DC-10-30. Again, the Concorde is shown for reference.

Today, the Concorde is providing the passenger with a tangible benefit for increased fare (fig. 10). This is the saving of travel time with the increase in usefulness that shorter travel time affords. Subsonic aircraft offer amenities, deluxe service and extra spaciousness, as the only inducements for higher fares. To the average business executive this is not sufficient except in unique instances as the economy section is quite good enough and both sections arrive together at the destination. The Concorde has changed this.

It is very possible that the supersonic airplane of the 1980's will follow this lead and afford special value to the traveler, whether first class or full-fare economy. The discounted fares require low operating cost airplanes and, accordingly, the subsonic DC-10 type transports will continue to carry this type of passenger. Additionally, increased capacity subsonic transports are now on the drawing boards that offer even lower seat mile costs making the supersonic transport economics even less attractive for purely economy minded passengers.

In analyzing the 1974 North Atlantic yield per passenger nautical mile (fig. 11), it is readily apparent that the first class yield of over 8.1 cents/seat kilometer (15 cents/seat mile) far exceeds the yield of the other segments of the market. It is 75% higher than full-fare economy class and over 2-1/2 times as high as the 22-45 day excursion yield. It is also significant that the yield of full-fare economy class is 50% higher than for the 22-45 day excursion.

To put yield in perspective, the total operating costs shown earlier (fig. 9) were 1.9 cents/seat kilometer (3.5 cents/seat mile) for the DC-10-30 and 2.4 cents/seat kilometer (4.4 cents/seat mile) for the MDC-AST in 1976 dollars. Also, the Concorde was shown at about 4.3 cents/seat kilometer (8 cents/seat mile) or about twice the DC-10-30. These total operating costs are well under the yield of first class and, in the case of the MDC-AST and DC-10-30, well under the full-fare economy; however, the DC-10-30 alone of the three looks attractive for the discounted fare low yield passenger market.

The North Atlantic market share that seems to be important for a supersonic airplane (fig. 12) can be roughly estimated to be 19% of the passengers who provide 27% of the revenue. The remaining 81% of the passengers would continue to be served by subsonic transports. Not all of the full-fare economy passengers can be expected to patronize supersonic service due to schedule problems, lack of traffic density, or other reasons.

In the McDonnell Douglas in-house studies, various market penetrations for supersonic travel have been investigated (fig. 13). Each city-pair seems to require a different penetration assumption, dictated by the historical market split between business and pleasure travel. Typical assumptions for market penetration range from a low of 17% from the recreation dominated Honolulu to Los Angeles market, to heavily business dominated routes like New York to Rio de Janeiro at 40%.

There are market penetration variations by service and by fare for supersonic service (fig. 14). One Concorde manufacturer varies market penetration with the ratio of total operating cost relative to competitive subsonic designs. To that basic curve can be added the values being used by McDonnell Douglas on some in-house studies. These values for the supersonic airplane are 90% penetration for the first class market, 50% for the full-fare economy market and zero penetration for the discount market. It can be seen that on this basis the Concorde penetration will be small relative to what can be offered in a more economical second-generation supersonic transport, with low total operating costs.

One route was examined in detail, the North Atlantic (fig. 15). For this example, two cases were postulated. Case one assumed the DC-10-30 carried all the passenger traffic and realized the revenue just as it existed by class for the 1974 scheduled services offered. 1975 operating cost assumptions were used. The system resulted in a breakeven load factor of 43 percent for an all DC-10 fleet.

The second case assumed the traffic to split as described earlier. Initially, the airplane seating capacities did not match the traffic demand and the passenger split of both aircraft had to be tailored to match the markets. The 10% first class penetration for the DC-10-30 resulted in only one first class passenger per flight in the subsonic airplane so a high density 328 seat DC-10-30 was selected. The supersonic airplane on the other hand could not accommodate all the first class passengers of the market and accordingly a 35% first class, 65% full-fare economy split had to be obtained. The 273 seat MDC supersonic design fuselage became a 251 seat design to match the split in the market between first class and 50% of the full-fare economy.

The load factors that resulted, assuming no change to the 1974 fares levels, showed that the supersonic design at 35% load factor not only was competitive but was even slightly better than the all subsonic case. This is extremely important as it shows that a supersonic airplane can be a profitable investment for an airline and does not need fare increases to support it. Also, a 251 passenger airplane may actually be too large, 225 passengers may be better.

While there is every reason to believe that a fleet of supersonic airplanes can be operated by the airlines with no increase in fares (fig. 16) for first class or full-fare economy, indications are that a small increase in fares for all services can be tolerated without a loss in market share. This would increase the profitability of the entire airline system.

As of now, our market trend studies indicate that a 225 passenger supersonic airplane may better match the anticipated passenger demands through the year 2000. A typical interior arrangement is shown (fig. 17), which has 77 passengers in first class and 148 passengers in full-fare economy, almost all arranged in spacious 4 abreast accommodations.

McDonnell Douglas/NASA 1973 studies, more conservative than either Boeing or Lockheed, showed a large potential market for an advanced supersonic airplane from the mid-1980's to the end of the century. Present estimates (fig. 18) are that 250 to 300 aircraft would still be needed through the year 2000, even making allowances for high fuel costs and higher operating costs. Assuming a purchase price of approximately $110 million per airplane, this represents a $33 billion market. This is almost equivalent to the total free-world value - $42 billion - of all the civil aircraft sales in history up through 1976. This is an important market and the U.S. should try to capture a major part of it.

The future requirement for subsonic aircraft for these same over water long range routes is close to 700 DC-10-30's (or equivalent) to put the supersonic transport market in perspective.

A look at the history of one U.S. civil aircraft program (fig. 19) seems to portray how the second-generation supersonic airplane program could develop. Both represent non-competitive major airplane programs designed to serve the long haul passenger on the prime routes of the world. Only time will tell if history will once again repeat itself.

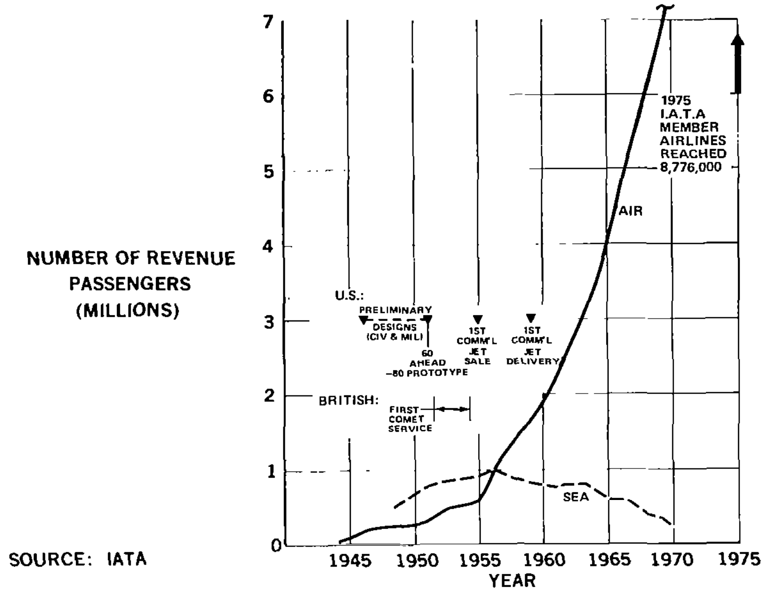

Figure 1.- North Atlantic traffic.

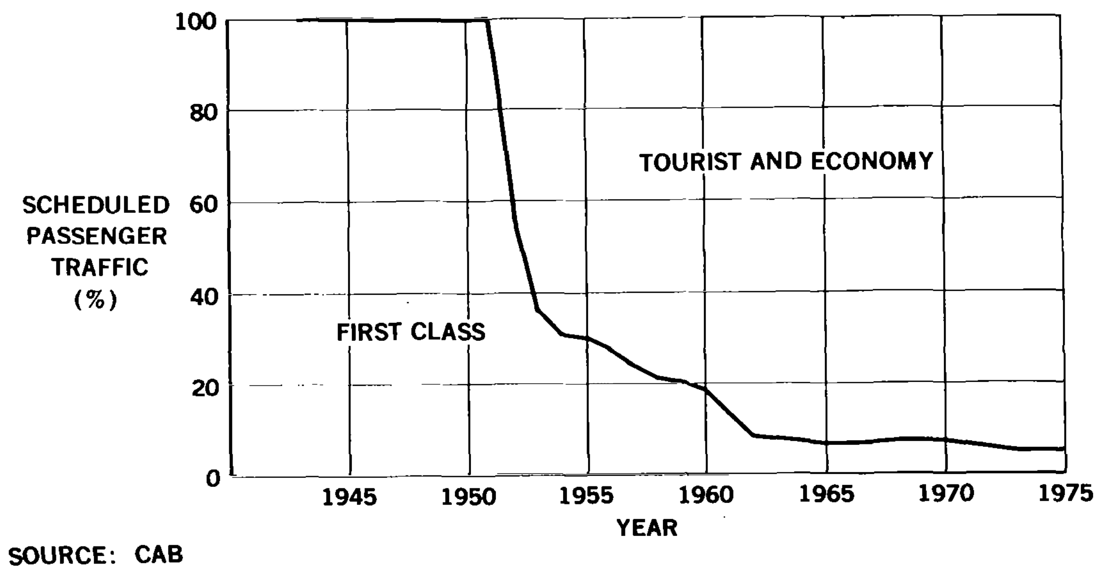

Figure 2.- Market share by mode - North Atlantic.

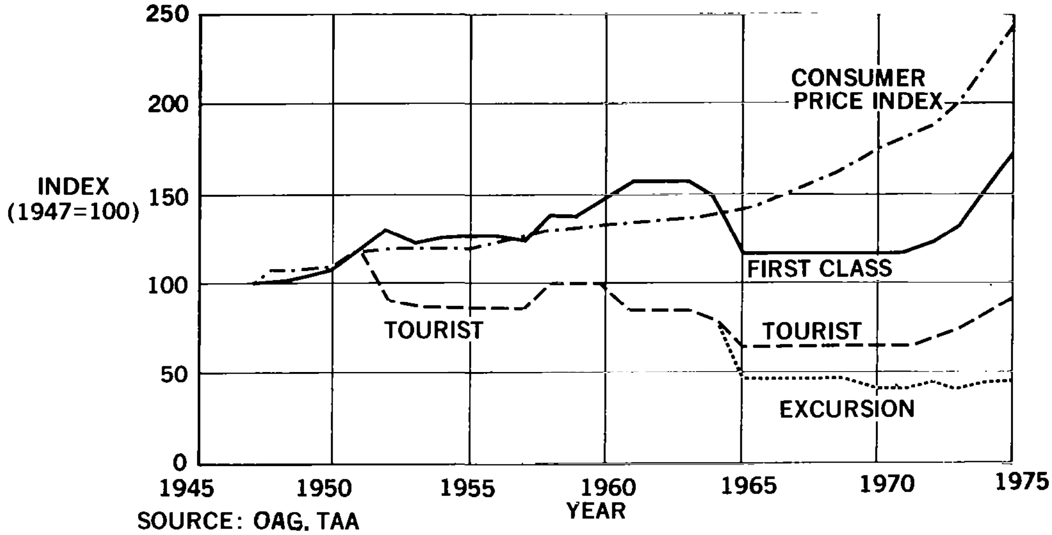

Figure 3.- North Atlantic fare trends versus consumer prices.

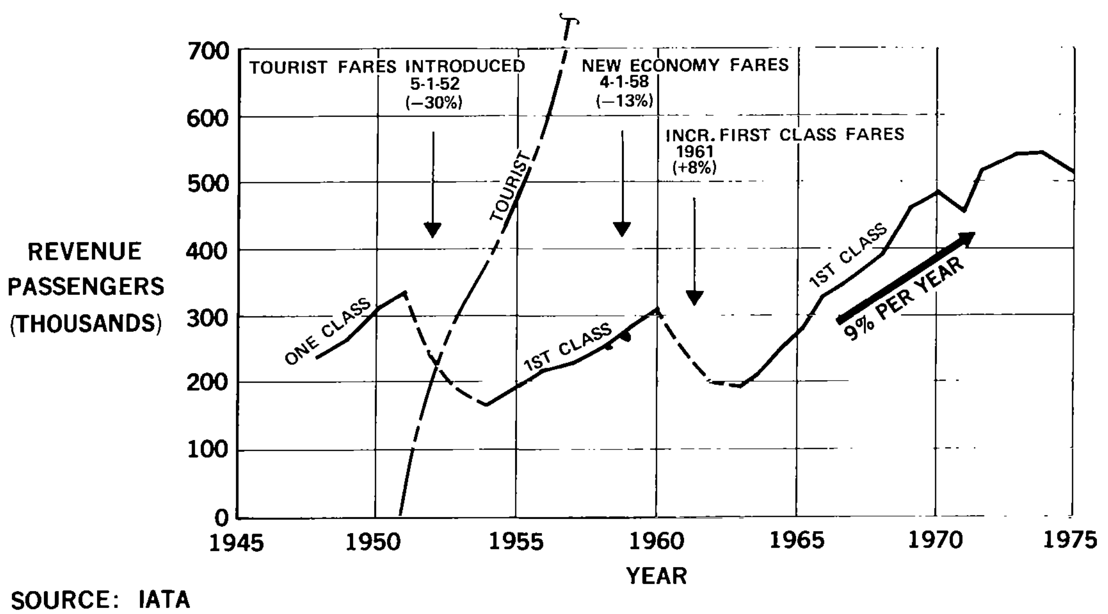

Figure 4.- History - 1st class market - North Atlantic.

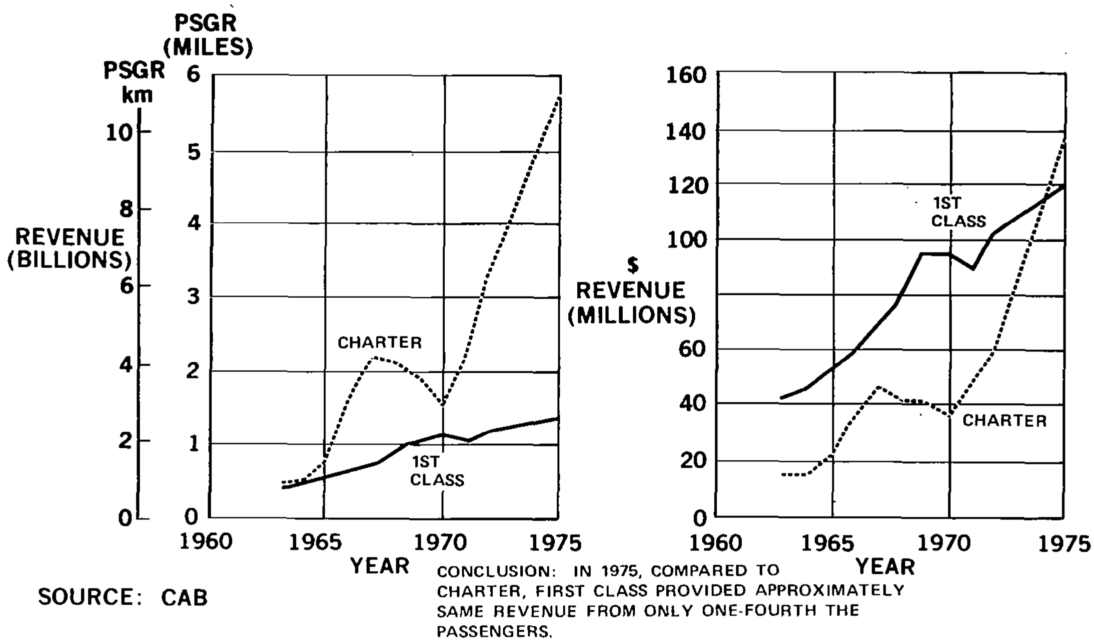

Figure 5.- 1st class market comparison with charter - TWA and PAA, North Atlantic.

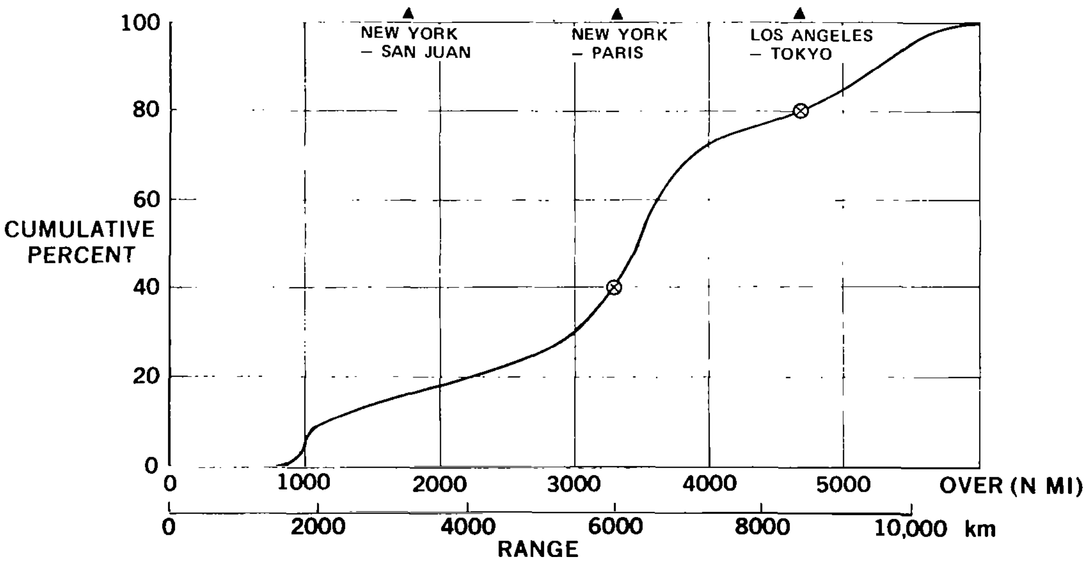

Figure 6.- AST revenue passenger-miles distribution by range.

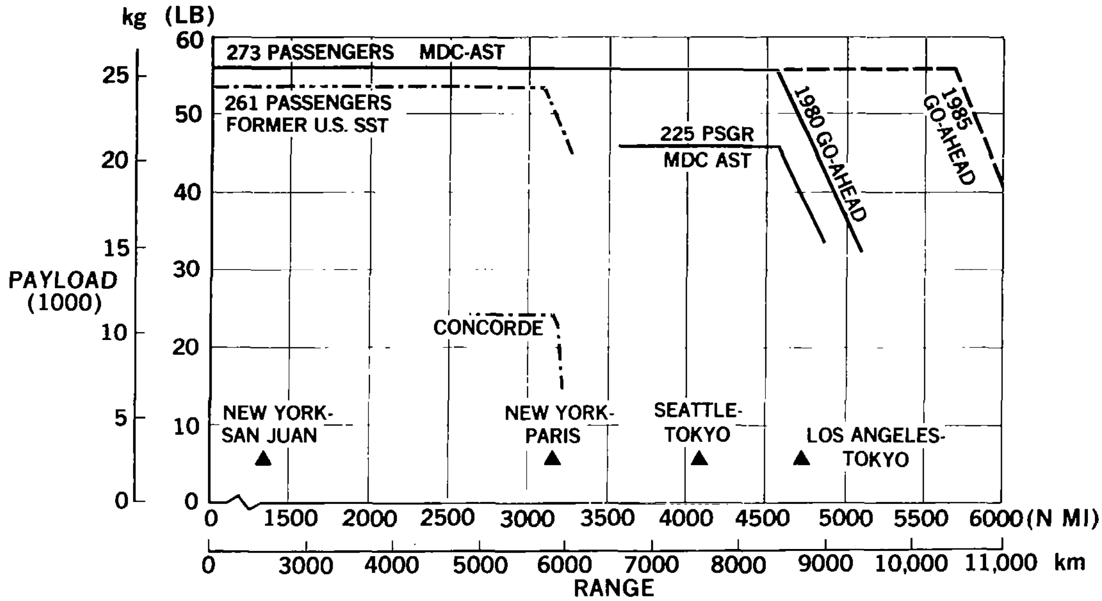

Figure 7.- Payload - range.

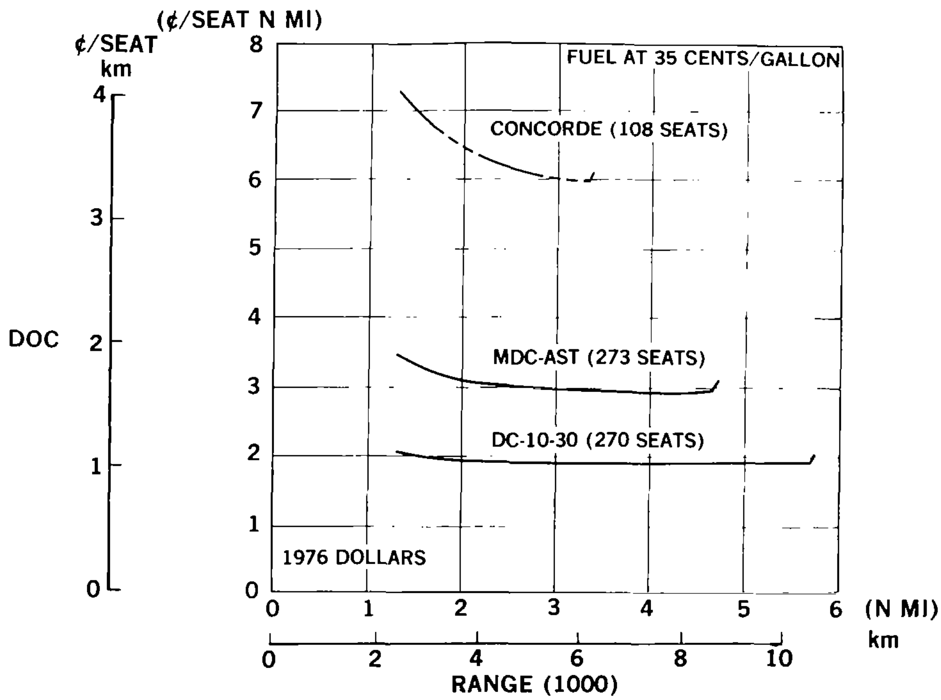

Figure 8.- Comparative direct operating costs.

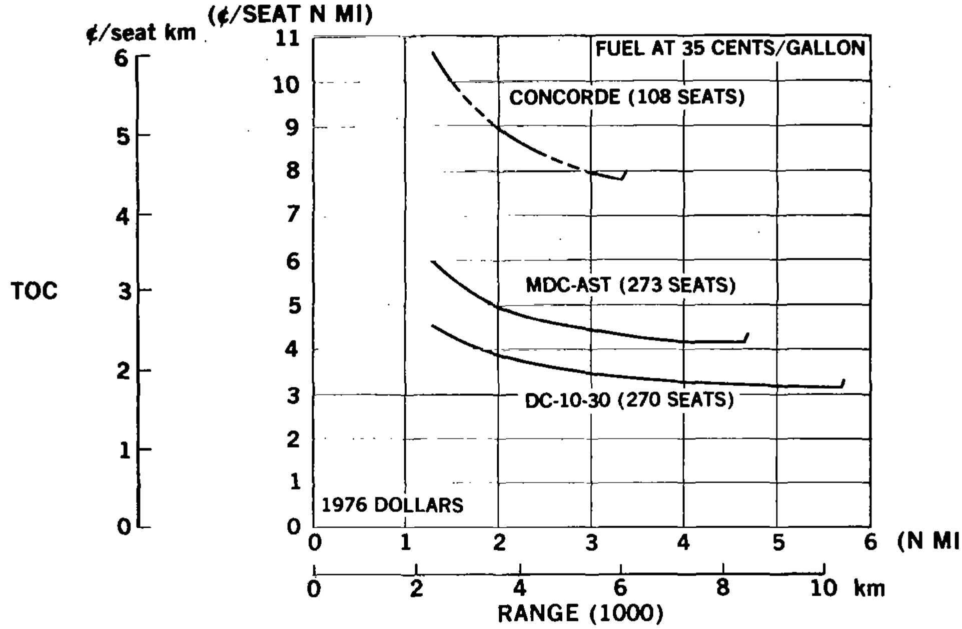

Figure 9.- Comparative total operating costs.

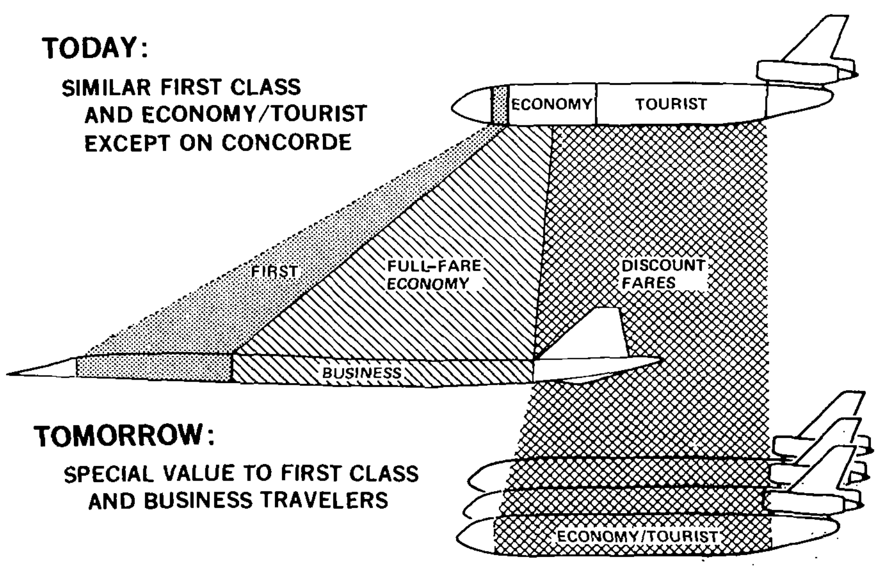

Figure 10.- Market separation by speed and fare.

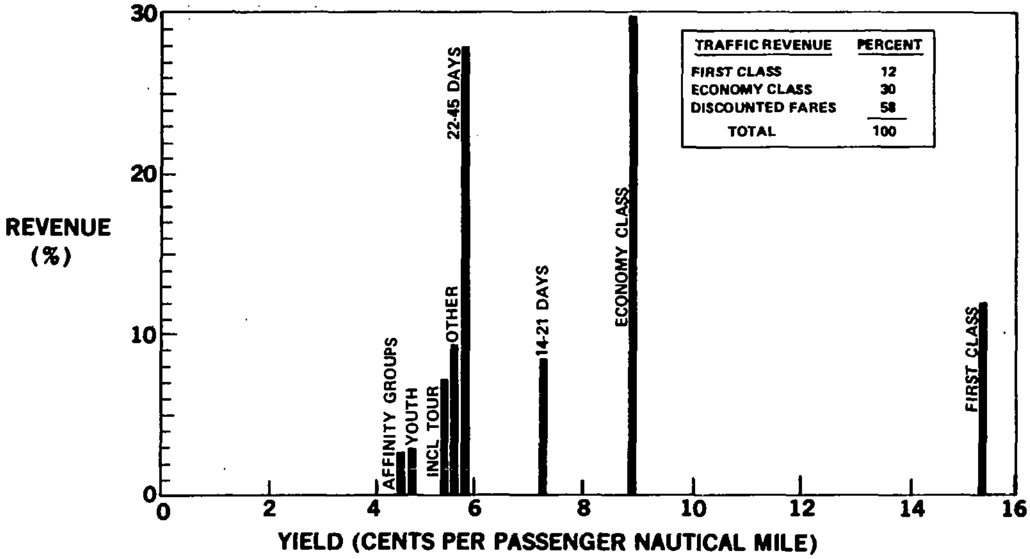

Figure 11.- Revenue distribution - 1974 North Atlantic scheduled passenger service.

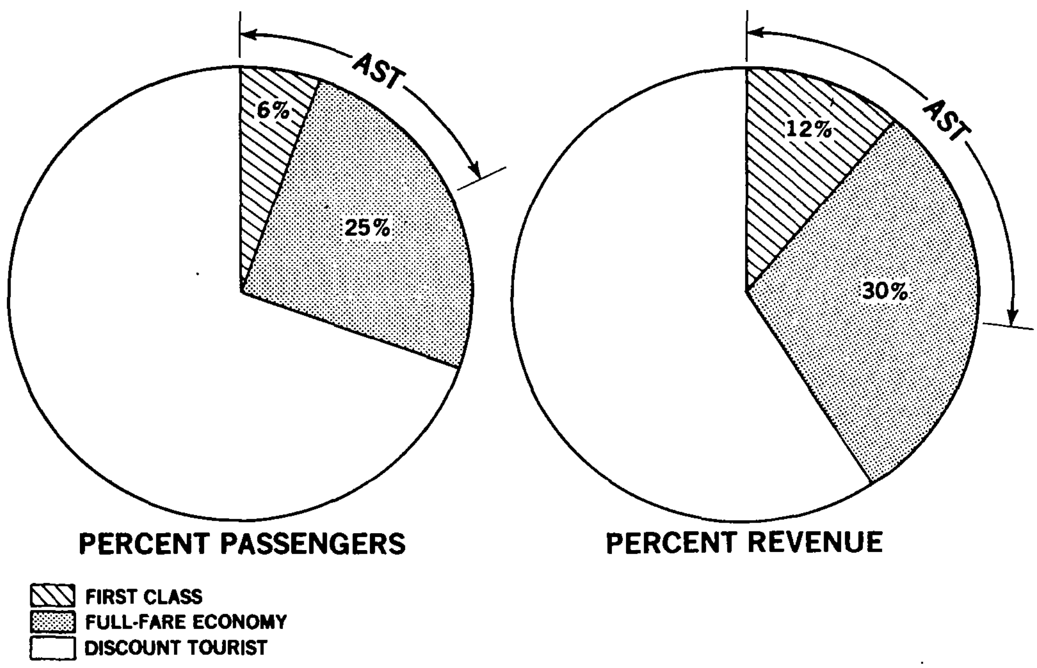

Figure 12.- Market shares - North Atlantic.

CITY-PAIR	PERCENT PENETRATION
HONOLULU-LOS ANGELES	17
HONOLULU-SEATTLE	20
HONOLULU-TOKYO	14
HONOLULU-SYDNEY	30
NEW YORK-LONDON	18
NEW YORK-FRANKFURT	17
NEW YORK-SAN JUAN	16
NEW YORK-MIAMI	12
NEW YORK-RIO	40
ETC.	

BASED ON 90-100% FIRST CLASS
50% FULL-FARE ECONOMY

Figure 13.- Typical market penetrations.

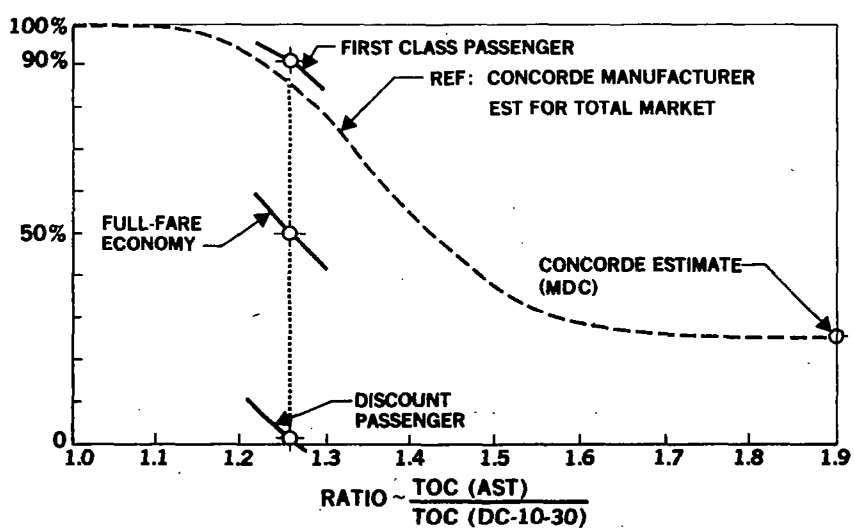

Figure 14.- Market penetration versus total operating cost.

NORTH ATLANTIC PASSENGER TRAFFIC — 1974
SCHEDULED SERVICE — RELATED FARES

TODAY

(IF DC-10 CARRIES ALL TRAFFIC)	DC-10-30 (270 SEATS)	AST (273 SEATS)
B-E LOAD FACTOR	57%	—

TOMORROW

(IF TRAFFIC SPLITS)	(328 SEATS) 10% FIRST CLASS 50% ECONOMY CLASS ALL DISCOUNTED TRAFFIC	(251 SEATS) 90% FIRST CLASS 50% ECON CLASS NO DISCOUNTED TRAFFIC
B-E LOAD FACTOR	53%	48%

Figure 15.- Relative breakeven load factors.

CASE 1

FIRST CLASS — SAME AS TODAY

FULL-FARE ECONOMY — SAME AS TODAY

DISCOUNTED ECONOMY — SAME AS TODAY

BUT: THIS PROVIDES AIRLINES WITH LESS PROFIT THAN TODAY'S SUBSONIC OPERATIONS

CASE 2

FOR SAME AIRLINE PROFITS AS TODAY, INCREASE ALL FARES BY 10%, WHICH SEEMS DEFENSIBLE!

Figure 16.- Airline fare options for North Atlantic case.

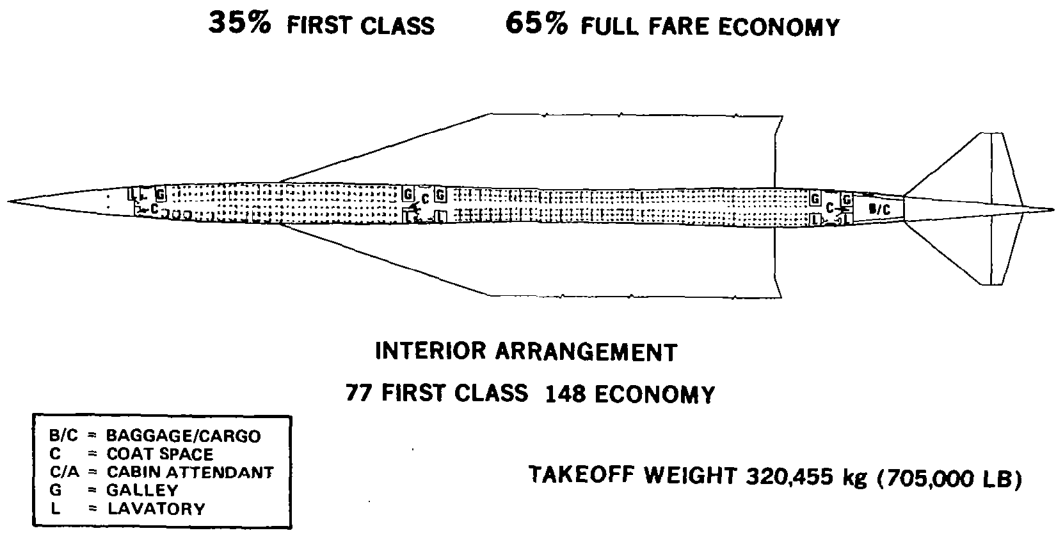

Figure 17.- 225 passenger AST.

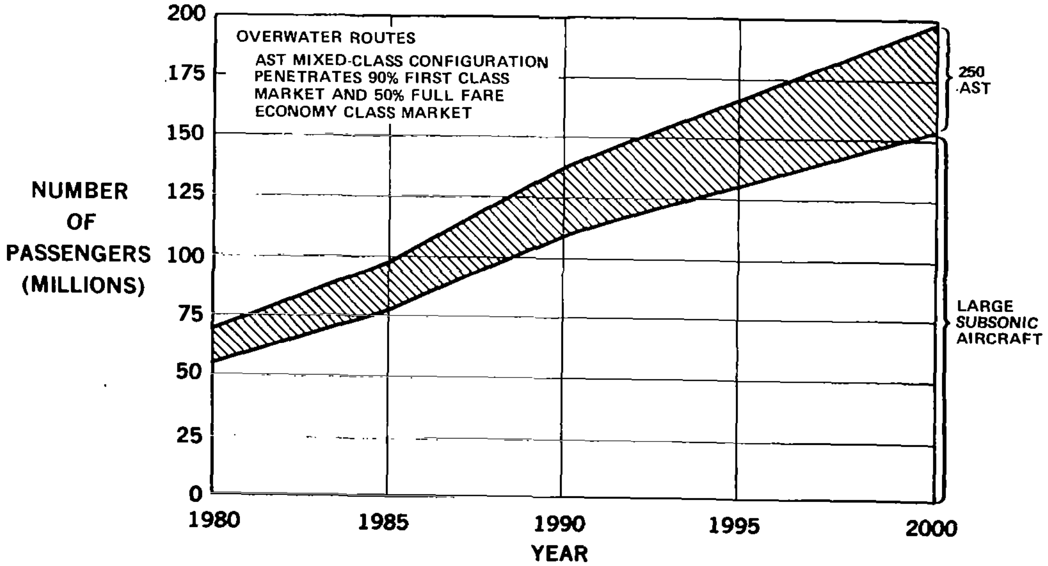

Figure 18.- Passengers by aircraft type, 1980-2000.

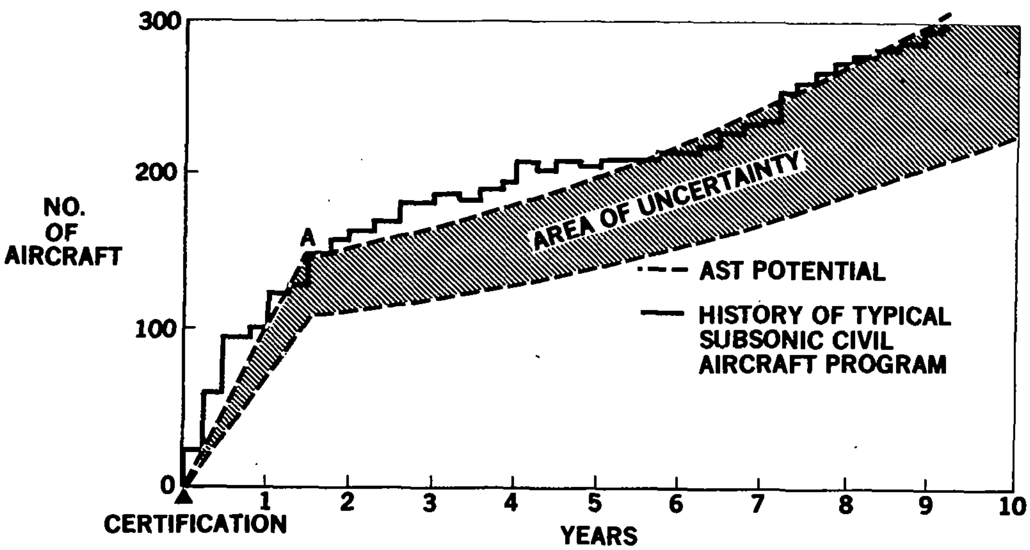

Figure 19.- AST market buildup.