

## BUSINESS AVIATION

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## INTRODUCTION

The 1980s were a time of adjustment for business aviation. Costs and prices rose. Markets for turbine-powered aircraft became thinner as a result of slower economic growth, recessionary pressures on corporate earnings and profits, and increased merger and takeover activity. Growth in the active U.S. business aircraft fleet and the use of the fleet slowed as an increasing number of business turbine-powered aircraft left the country to be placed in operation overseas.

In response to these market changes, aircraft manufacturers consolidated operations and rationalized product lines around the new economics of business aviation. Except for specialty aircraft, the manufacture of piston aircraft nearly ceased. The production of turboprop aircraft consolidated with one viable U.S. manufacturer (Beech) producing five different turboprop models. Shipments of new business jets stabilized around 260 units per year, which seems to be a level that can sustain minimally profitable operations for the surviving manufacturers.

Business aviation is now entering another transition period. New forces are at play, and it is likely that the business aviation industry will have to adjust once again to changed circumstances. The panel identified the following as major forces that will shape business aviation in the coming decade: (1) a maturing U.S. domestic market, (2) uncertainty about the fleet of used business aircraft and the linkages between market segments, (3) increasing importance of foreign markets, (4) the level of new product development, and (5) changing expectations among corporate buyers and other operators of business aircraft.

## BUSINESS AVIATION FORECAST

As a context for discussion of the forces that will affect business aviation, the panel developed an overview forecast of new aircraft shipments, the business aircraft fleet, and flight hours through 2001. The shipment forecast is for worldwide shipments, while the fleet size and fleet hour forecasts are for the U.S. domestic fleet of active aircraft. The values for fleet size and fleet hours are preliminary estimates that are likely to be revised downward when the results of the 1990 FAA General Aviation Activity and Avionics Survey are reported. For this reason, 1989 values were used as base points for forecasts of fleet size and fleet hours. 1990 is the base value for aircraft shipments.

Annual shipments of new business jet aircraft worldwide are expected to increase from approximately 262 units in 1990 to approximately 317 units by 2001. (Table 1) This corresponds to an average annual growth rate of 1.7 percent over the coming decade. The U.S. domestic jet fleet was forecasted to grow at an average annual rate of 1.9 percent, reaching just over 5,500 by 2001. Total jet fleet hours were expected to increase at an average annual rate of 1.6 percent over the forecast period. The forecasts for fleet size and fleet hours suggest a slight decline in average jet hours flown.

The turboprop forecasts show greater strength over the forecast period. (Table 2) Annual shipments of new business turboprop aircraft worldwide are expected to increase from 144 units in 1990 to approximately 339 units in the year 2001. This corresponds to an average annual growth rate of 8 percent, which is much more optimistic than the jet aircraft forecast. Growth at this rate would be quite a departure from recent trends, and

the shipments forecasted for 2001 (if realized) would reposition the turboprop segment to where it was in 1975.

There was general agreement among the panelists that the turboprop forecast presented here requires that several conditions be met. The single-engine business turboprops currently under development must hit a particularly active market niche. Engine and airframe manufacturers would have to cooperate in developing engine specifications and design and production techniques that reduce engine development and fabrication costs. More manufacturers would have to enter the market. Marketing efforts would have to be expanded and intensified. The development of new markets in eastern Europe and the former Soviet republics might also be of great significance.

TABLE 1 BUSINESS JET AIRCRAFT FORECASTS\*

YEAR	SHIPMENTS WORLDWIDE	U.S. FLEET	U.S. FLEET HOURS(000)
1970	107	950	474
1971	61	991	481
1972	193	1123	592
1973	258	1406	703
1974	252	1579	806
1975	262	1776	874
1976	253	1938	1000
1977	335	2277	1165
1978	336	2480	1197
1979	395	2653	1259
1980	461	2992	1332
1981	573	3171	1387
1982	431	3996	1611
1983	257	3898	1473
1984	262	4320	1566
1985	239	4375	1622
1986	206	4480	1654
1987	221	4338	1528
1988	260	4187	1678
1989	252	4402	1654
1990	262	4441	1685
1991	267	4526	1707
1992	306	4647	1743
1993	291	4748	1773
1994	284	4837	1801
1995	293	4931	1830
1996	301	5029	1860
1997	298	5120	1887
1998	307	5216	1916
1999	315	5316	1947
2000	312	5410	1976
2001	317	5504	2005

\*Historical data 1970 to 1989 (1990 for shipments) forecasts thereafter

TABLE 2 BUSINESS TURBOPROP AIRCRAFT FORECASTS

YEAR	SHIPMENTS WORLDWIDE	U.S. FLEET	U.S. FLEET HOURS(000)
1970	162	1458	970
1971	137	1492	958
1972	241	1509	1042
1973	309	1865	1126
1974	305	2120	1247
1975	338	2519	1326
1976	373	2436	1267
1977	484	2790	1429
1978	567	2980	1431
1979	659	3379	1649
1980	804	3834	1845
1981	899	4428	1785
1982	412	4890	1770
1983	242	5167	1649
1984	204	5433	1873
1985	215	5078	1617
1986	124	5169	1550
1987	124	4973	1689
1988	117	4857	1542
1989	108	5662	2071
1990	144	5745	1899
1991	75	5806	1913
1992	105	5884	1920
1993	297	6066	1950
1994	226	6208	1971
1995	189	6330	1987
1996	235	6476	2009
1997	277	6644	2038
1998	263	6804	2063
1999	308	6988	2092
2000	348	7193	2127
2001	339	7392	2160

\*Historical data 1970 to 1989 (1990 for shipments) forecasts thereafter.

The domestic business turboprop fleet was forecasted to increase to 7,392 aircraft by 2001, corresponding to an average annual growth rate of 2.2 percent. Total turboprop hours were forecasted to increase more slowly, 0.35 percent annually, reflecting a decline in turboprop utilization.

The accuracy of the business jet and turboprop forecasts will also depend on major market drivers: corporate performance measured by profits and retained earnings, new product developments and how they match with market niches, prices and price-performance differentials among business aircraft market segments, fleet characteristics including age of aircraft and the extent of overcapacity in the turbine-powered aircraft fleet, the continued development of foreign markets, and the regulatory environment.

### A MATURING U.S. MARKET

The current growth profile for the domestic business turbine fleet suggests that the U.S. business aircraft market is maturing. Figure 1 shows the U.S. business aircraft fleet for the years 1965 to 1990, using a logarithmic scale. The slope of the curves represents the percentage of change. It is evident that overall growth in both the turboprop and jet domestic fleets stopped in 1985, even though certain segments continued to grow. The shape of this curve, representing a declining growth rate over time, is consistent with the traditional market concept of product life cycle and the hypothesis that markets eventually mature and become saturated.

Additional evidence is provided in Figure 2, which incorporates a graph of the U.S. multi-engine piston aircraft fleet that exhibits a similar flattening of the growth curve. It appears that the multi-engine piston market matured around 1980 and began to shrink around 1985, the same year that the jet and turboprop markets reached maturity. The multi-engine piston fleet curve could be the precursor of the turbine-powered fleet curve.

A third piece of evidence indicating a maturing U.S. domestic market for business turbine aircraft is the size of the domestic retail fleet and the number of aircraft owners in the 1984-1991 period. (Figure 3) The number of aircraft exceeds the number of owners, suggesting an average retail fleet size of approximately 1.5 aircraft. The turboprop retail fleet and the number of turboprop owners peaked around 1986 and have declined since. The retail jet fleet and the number of retail owners have increased steadily over the 1984-1991 period, but at a diminishing rate.

If, in fact, the U.S. market for business jet and turboprop aircraft is maturing, there are significant implications for aircraft manufacturers and suppliers, who must realize that a mature market is a more price-sensitive market. Sales of new and used aircraft will depend more heavily on changes in prices and interest rates. Growth in shipments and the domestic business fleet will be influenced by the introduction of new products and the extent to which they meet consumer preferences, especially in the international market.

There would also be repercussions for the Federal Aviation Administration in the form of need for flight services, demand on the air traffic control system, and airport capacity. FAA may need to reevaluate its forecasts of business aviation activity, facilities requirements, and controller workload, taking into consideration the maturation of the U.S. business aircraft market, the increasing importance of foreign markets, and the flow of business aircraft from the domestic fleet.

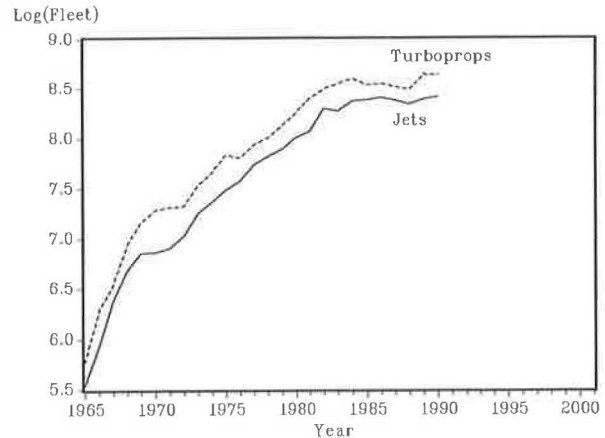


FIGURE 1 U.S. turbine-powered aircraft fleet.

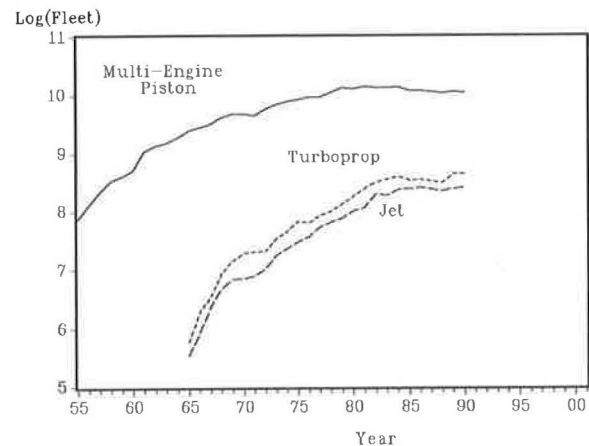


FIGURE 2 U.S. business aircraft fleet (turbine-powered and multi-engine piston).

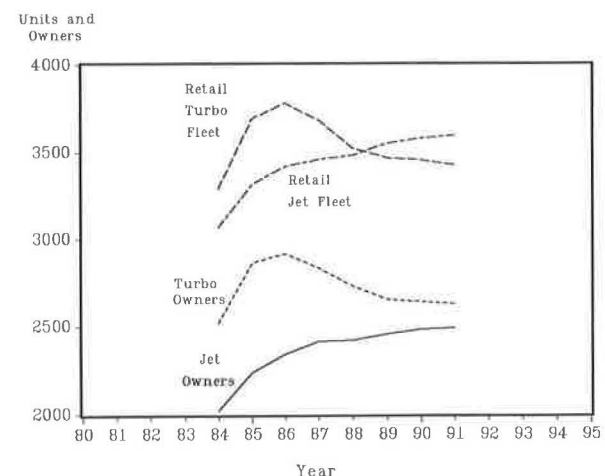


FIGURE 3 Domestic retail aircraft and owners.

The turbine forecasts developed by the panel indicate continued growth in shipments, fleet size, and fleet hours. On the surface, this is contrary to the hypothesis that the U.S. turbine market has matured. It is likely that the overview forecast can be realized only if the business aircraft industry avoids real price increases and successfully develops and introduces new products that appeal to changing buyer preferences for executive air travel. The new products must encourage current owners and operators to trade up and trade in, and at the same time entice new buyers of jet and turboprop aircraft into the market.

### THE WORLDWIDE MARKET FOR USED BUSINESS AIRCRAFT

The most recent data show that the major growth in business aviation is taking place outside of North America. This is consistent with the hypothesis that the U.S. domestic market has matured. Worldwide, the turbine-powered aircraft fleet increased 2.6 percent from 1990 to 1991. However, this growth was not evenly distributed geographically. The North American turbine-powered aircraft fleet showed virtually no growth, while the European and South American fleets grew 9.6 and 11.3 percent, respectively. (Table 3)

TABLE 3 GROWTH IN WORLDWIDE BUSINESS FLEET

REGION	PERCENTAGE CHANGE 1990-1991		
	JETS	TURBOPROPS	TOTAL
Worldwide	3.9	1.5	2.6
North America	1.0	-1.0	0.
Europe	13.0	6.4	9.6
South America	13.6	10.3	11.3
Central America	10.3	2.7	7.0
Asia	2.6	3.6	3.0
Africa	6.2	7.0	6.7
Oceania	2.2	-4.0	-2.0

Four-year trends confirm the increasing importance of Europe, South America, and Central America, with commensurate decline in the North American fleet. In 1988 the North American fleet accounted for about 73 percent of the world's business aircraft. By 1991 the North American share had declined to 68 percent. On the other hand, shares increased from 10.9 to 13 percent in Europe, 5.9 to 7.3 percent in South America, and 3 to 3.6 percent in Central America. The remaining regions maintained market share at their 1988 levels. In large part, the growth rates in areas outside the United

States reflect the increasing globalization of business and trade.

The pattern is clear; business jet and turboprop aircraft have been leaving the North American fleet and going to Europe and Latin America. The United States has been a net supplier of used aircraft to the rest of the world, which has led to attrition of the domestic business aircraft fleet at the rate of roughly 0.5 percent annually since 1972.

Can the United States continue to be a supplier of used aircraft to the rest of the world? The answer is yes. Sales of new turbine-powered aircraft to those who presently own airplanes will continue. However, the U.S. fleet will not grow appreciably because somewhere in the daisy chain of trade-ins an airplane will not be resold in this country but be shipped overseas. There is some evidence suggesting a significant overhang of used aircraft on the world market, and presumably these are aircraft that are or were formerly registered in the United States.

Figure 4 shows the average number of aircraft for sale and the total number of aircraft sold, from the fourth quarter of 1989 through the first quarter of 1991. In 1989 the worldwide used turbine aircraft market was close to equilibrium. By the first quarter of 1991, after a three-year period of rising used aircraft prices, a significant excess supply of used turbine-powered aircraft had developed. Over this six-quarter period the number of available aircraft increased by nearly 70 percent while the number of aircraft sold per quarter declined 38 percent. By the first quarter of 1991 quantity supplied (i.e., available) exceeded actual sales by 1,176 units. This overhang suggests an abundant supply of turbine-powered aircraft to support growth in international fleets. Real used aircraft prices will have to retreat, however, to clear the market.

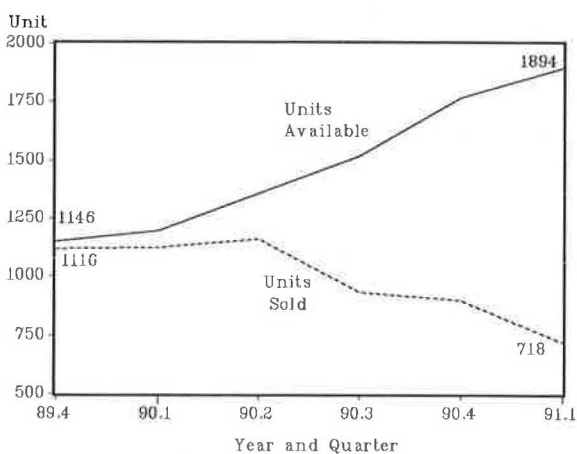


FIGURE 4 Worldwide turbine-powered aircraft market.

Because the U.S. fleet dominates the world fleet, the demand-supply gap in the world market raises questions that deserve further investigation and research. How many turbine aircraft are really active and available? Perhaps the FAA should consider tracking aircraft that have very low use rates by means of the General Aviation Activity and Avionics Survey to obtain a better measure of business aviation activity. What is happening to buyer views about airframe and engine times? At what point do the owners of unmarketable business aircraft simply park them but not take them off the U.S. registry? While there is some market evidence suggesting that jet and turboprop aircraft become unsalable when airframe and engine times reach 4,800-5,200 hours, the acceptance threshold is increasing as the availability of low-time aircraft diminishes and more of the fleet has over 5,000 accumulated hours. 10,000 hours may become the next threshold.

Will foreign markets continue to expand and absorb business aircraft released from the U.S. fleet? These aircraft can provide better service and efficiency than the relatively older aircraft now common in foreign fleets. Moreover, aircraft sold on the world market tend to be dollar-denominated assets, providing foreign buyers with a relatively liquid capital investment. The panel raised the question whether the excess supply of used aircraft means that prices for used aircraft will soon fall. Many operators and owners may be reluctant to place used aircraft on the market because they were purchased during the recent speculative period when used-aircraft prices were rising.

Perhaps most important from the perspective of business aircraft manufacturers, will the outflow of used aircraft from the U.S. fleet, in conjunction with replacement the aging fleet, create a significant increase in the demand for new turbine-powered aircraft? Will current owners of multi-engine piston aircraft move into the used turboprop market for replacements? Given the dearth of turboprop production, will current owners and operators of top-end turboprop aircraft move into entry-level jets? How does the increasingly important foreign market affect the trade-up linkages between piston, turboprop, and jet business aircraft in the U.S. market?

Certain events must take place in the used-aircraft market for continued growth in the market for new aircraft. Trade-up linkages must be established between piston, turboprop and jet markets. The business aircraft industry must identify new customers in the United States. Analysis of shipments, fleet growth, and attrition suggests that the turbine industry must capture nearly 600 new jet owners and 500 new turboprop owners over the next decade. Low growth in the U.S. fleet means that sales of new aircraft will result in the export of used

aircraft. If foreign fleets are going to absorb the outflow of used aircraft from the U.S. fleet, the foreign jet fleet must increase by approximately 70 percent and the turboprop fleet by 50 percent over the next 10 years. Worldwide, the industry will have to find almost 1,500 new jet customers -- either first-time aircraft owners or from among the 4,900 present owners and operators of turboprop aircraft. At the same time, the industry must have a net increase of 1,100 new turboprop customers to sustain the forecasted growth in this market segment. The increase in jet owners is likely to come from turboprop owners, and the new turboprop owners are likely to come from current owners of piston aircraft.

## CHANGING BUSINESS PREFERENCES AND NEW PRODUCT DEVELOPMENT

Unprecedented new product development is under way among aircraft and engine manufacturers and avionics suppliers. New single-engine turboprop aircraft (e.g., the Pilatus PC-12 and TBM 700) may soon enter the business aviation market. New entry-level jets, such as the Swearingen Jet and CitationJet now under development, will be comparable in price to currently produced turboprop aircraft. New medium-sized business jets (the Citation X and Lear 60) are being developed, and it is becoming increasingly difficult to distinguish between the new larger medium jets and the present large jets, as performance improves in the medium business jet category. To the extent that these new products are successful, modest expansion of the domestic fleet and continued growth of the overseas market for U.S.-made business aircraft can be expected.

A critical point discussed by the panel was how well these new products will meet the changing preferences of corporate buyers and operators. Corporate executives and corporate flight departments are looking for increased comfort (cabin volume, stand-up room), increased range (transcontinental and intercontinental), improved speed (exceeding Mach 0.8), and lower operating costs. Many of the new products expected on the market during the mid-1990s are designed to meet these buyer preferences. Further advances, however, probably depend on the ability of engine manufacturers to develop new engines with enhanced performance characteristics.

Next generation jet aircraft available sometime after 1995 can be expected to have cruise ranges of 4,300 to 5,500 nautical miles, cruise speeds in the Mach 0.83-0.87 range, and cabin volumes exceeding 1200 cubic feet. The next generation of engines will have 20 percent more airflow per sq. ft. and 10 percent greater thrust-to-weight



ratio. Along with these improvements, the next generation of engines will be of simpler design (up to 30-40 percent fewer parts), and hence less costly to fabricate. They will also have lower cost of operation and maintenance. All of these engine enhancements will improve the opportunities for airframe manufacturers to develop turbine aircraft to meet future market demands for longer range, higher speed, and more comfortable business aircraft.

## CONCLUSIONS

The panel concluded that 1991-1992 will be another transition period for business aviation activity. Domestic sales, fleet growth, and fleet utilization will likely reflect the characteristics of a maturing market and a slow economy: market saturation causing slow growth and both factors bringing increased sensitivity to prices. Changes in business aviation activity in the United States, spurred by new product introductions, will mirror real economic growth.

Overseas sales and expansion of foreign fleets will drive industry expansion through the beginning of the 21st century. Europe, Central America (including Mexico), and South America have the greatest market potential, while very modest growth in business aviation activity is expected in Asia. Expansion of foreign fleet

operations depends on continued growth in the world economy, investments in new technology, rationalization and reorganization of fragmented air traffic control systems, and continued favorable international trade conditions.

If the overseas market potential is realized, shipments of new jet and turboprop aircraft will grow in the United States, Europe, and Latin America. As new jet aircraft are introduced, used business jet aircraft will become available to support expansion of jet fleets overseas. Further, as U.S. turboprop operators shift to jets, market, turboprop aircraft will be released to accommodate trade-up by multi-engine piston aircraft operators and expansion of foreign turboprop business fleets.

In light of this forecast, FAA may wish to reexamine its forecast for domestic business aviation activity. Because international markets are expected to play a pivotal role for the business aviation industry in the 21st century, FAA may also wish to initiate study of the international flow of new and used turbine aircraft and changes in fleet activity in key foreign countries or regions. In addition to tracking the U.S. fleet, FAA should consider gathering information on the worldwide fleet. This may involve collating and reporting information collected by counterpart organizations in major foreign countries. A better understanding of business aviation activity worldwide would improve FAA's ability to forecast changes in U.S. business aviation.